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A European safe asset to complement national government bonds*

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Abstract

This paper expands the growing literature on common safe assets in the context of the euro area financial system by employing credit risk simulation techniques to investigate the properties of different safe asset models and their impact on national bond markets. The paper explores in particular the E-bonds model, whereby a supranational institution would raise funds in the markets and provide bilateral senior loans to Member States corresponding to a fixed proportion of GDP, complementing the issuance of national government bonds, without risks of mutualisation. The main findings are that E-bonds could reach a volume of 15 to 30% of euro area GDP with a high degree of safety while becoming the reference safe asset for the banking sector, capital markets and monetary policy operations in the euro area. As regards the impact on remaining national bonds, such volumes would be consistent with Germany maintaining its top credit rating. The average funding costs of Member States would remain broadly stable, while marginal funding costs would tend to experience limited increases, which should enhance market discipline.

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Executive Summary

Issuing a sufficient quantity of homogeneous and attractive European safe assets would bring multiple benefits: it would reduce banks' exposure to *national* sovereign bonds, support a smooth and symmetric transmission of monetary policy, bolster the functioning of, and facilitate progress towards completing the Banking Union, create a benchmark for capital markets in Europe, buttress the international role of the euro and, depending on the construction, strengthen the incentives for sound national economic and budgetary policies.

Many proposals to create a safe asset made over the past decade assume a *Fiscal Union*, whereby common issuance would be backed by joint and several liabilities/guarantees from Member States, and the sharing of some national fiscal competences to mitigate the risks of moral hazard. In some cases, the instrument would help to finance deficit spending on common projects, making it akin to a “safe liability”. Other proposals look at the question from a *Financial Union* perspective, focusing on the “safe asset” side, that is how the current supply of sovereign bonds in the euro area could be reorganised so that one homogenous instrument of significant size could become the reference safe asset for financial markets.

Previous studies looking at constructions that do not require joint and several liabilities – and are hence compatible with the current EU legal framework (namely, Article 125 TFEU) – suggest that E-Bonds have attractive features in terms of safety, potential volume, liquidity, as well as of their impact on national bond markets and incentives for responsible fiscal policies, that deserve careful consideration in the ongoing discussions on deepening EMU.

This paper explores further the characteristics of “E-bonds”, whereby a supranational institution would raise funds in the markets and provide bilateral *senior* loans to Member States corresponding to the same proportion of GDP in each Member State. Governments would use these funds to refinance and replace a share of their maturing debt. With the appropriate calibration, seniority of the loans would ensure that neither existing nor future liabilities of any individual Member State would become liabilities of other Member States. Equally, no joint guarantees from Member States would be required. Subordination to the senior bilateral loans would only apply to newly issued national debt, implying therefore the grandfathering of existing sovereign debt.

Using multiannual data on sovereign CDS spreads and based on conservative assumptions to calibrate a benchmark simulation model, this paper finds that a common issuance of E-bonds could reach a volume of 15 to 30% of euro area GDP (around € 1.7 to 3.5 trillion) with a high degree of safety, including as regards tail risks, and limited impact on national bond markets. Combining low risk with large volumes, and covering all maturities, while remaining skewed towards shorter-term ones, E-bonds could become the most liquid safe asset in Europe, thereby transforming the landscape of financial markets and attracting both European and foreign investors. The simulations in this paper indicate that such a volume of E-bonds would barely affect Member States' average funding costs — with the exception of governments with low debt, who would

see significant overall cost reductions. At the same time, it would improve incentives for sound fiscal policies via the subordination of new national debt, which would consequently see its yield (and hence the marginal cost of funding) increase.

While there is clearly potential for higher volumes, it seems reasonable – given the uncertainties surrounding the phasing-in process – to start with a prudent approach and gradually expand the scheme size on the basis of experience. At 15% of euro area GDP and with issuance focused on short-term maturities, E-bonds would already deliver important benefits for all participating Member States as they: (i) would likely enjoy top credit quality comparable with the German bund whose triple-A credit rating would be preserved, (ii) reinforce incentives for sounder policies within the EMU fiscal framework as the marginal funding cost for high-debt countries would increase moderately, (iii) generate a very liquid short-term market, which is currently underdeveloped in the euro area when compared to the US, and (iv) become the reference safe asset for the banking sector and monetary policy operations in the euro area. As discussed in this paper, several positive dynamic and general equilibrium effects could materialise as the E-bonds volume approaches a critical mass. These effects need further assessment but their materialisation could support the case for further increasing the issuance size.

1 Introduction

The case for a European safe asset

The case for a common European safe asset is increasingly being debated in policy and academic circles. The proponents indicate that it could bring multiple benefits in the steady-state of a complete Economic and Monetary Union (EMU).¹

A common European safe asset could help sever the direct nexus between banks and sovereigns, notably by lowering banks' exposures towards national bonds. In particular, a safe asset could increase the underlying diversification while decreasing the credit risk of banks' sovereign portfolios if the latter were to reallocate proportionally their holdings of national bonds towards the common safe asset. In addition, it would also help to mitigate some of the risks and negative feedback loops that operate via other (indirect) channels,² including monetary policy transmission and private sector risk-sharing via capital markets.

In effect, monetary policy operations are affected by the availability and quality of safe assets. This important channel has grown in relevance in recent years, given the increasing scarcity and asymmetry in the supply of highly credit-rated sovereign debt in the euro area.³ These developments are thought to hamper the smooth and symmetric transmission of euro area monetary policy, including during periods of heightened market tensions, accentuating differences in lending and borrowing conditions.⁴ A common European safe asset could enhance the policy toolkit of the Eurosystem, notably by gradually establishing a benchmark euro area yield curve⁵ and facilitating the conduct of both regular open market operations and extraordinary asset purchases.

European capital markets would also benefit from a single risk-free rate curve that could serve for asset valuation and contribute to more integrated capital markets. Moreover, widespread holdings of this asset in the financial system could reduce the negative effects of asymmetric flights to safety,⁶ including financial instability, the tightening of financing conditions and the blunting of monetary policy transmission. As summarised by Constâncio (2019), "Monetary Union, Banking Union and Capital Markets Union are deeply intertwined.

¹For instance, as indicated in European Commission (2017), a European safe asset defined as a new financial instrument for the common issuance of debt, could reinforce integration and financial stability. The more recent contributions by European Commission (2019a) to the informal EU27 leaders' meeting in Sibiu and by European Commission (2019b) to the June 2019 Euro Summit stated that a European safe asset would be a beneficial stabilising tool to complete EMU.

²See, e.g., Bellia et al. (2019) for a review of the different channels.

³See, e.g., Cœuré (2019).

⁴See, e.g., Brand et al. (2019).

⁵See ECB (2014) and Nyman-Andersen (2018) for challenges in measuring the risk-free yields in the euro area.

⁶For a discussion of capital flights and divergent market behaviour in sovereign bond markets during the first two decades of the Economic and Monetary Union, see Monteiro and Vašíček (2019).

A European safe asset is a linchpin of the three projects (...) None of them can reach a smooth and full completion without it. Member States and European policy makers must now take seriously the creation of such vital component of the European financial architecture.”⁷

As a corollary, a common safe asset would also help to underpin the international role of the euro.⁸ Without well-developed and integrated financial markets, the euro may not reach its true potential in the global economic arena, especially compared to the US dollar. Deep and broad financial systems are built around publicly-issued and liquid safe assets, which contribute to an increased demand for that currency among international investors.⁹

Importantly, as fiscal discipline is a key tenet of EMU, the introduction of a common safe asset could improve incentives for responsible fiscal and economic policies by increasing the marginal cost of debt issued individually by governments, as in the E-bonds model. This could contribute to the envisaged simplification of the current fiscal framework in EMU, complementing it with more reliable and clearer market signals in response to fundamentals and policy action by governments.

How to construct a European safe asset

While there is a broad recognition (but clearly not yet a consensus) on the potential benefits of a European safe asset, there are widely different proposals and views on how to achieve it. The different constructions display varying emphasis on different characteristics. Figure 1 provides an indicative mapping of the available design options, across the combined dimensions of liquidity, financial stability, and shared governance on the one hand, and the implications for market incentives and fiscal discipline on the other hand.¹⁰

Given the broad legal and political issues that are raised by constructions that aim to fund new forms of public spending and/or entail mutualisation, the debate has recently turned to models that aim to increase the supply of safe assets in financial markets without mutualisation, with the objective of generating a common European benchmark and exploiting synergies in the refinancing of existing national debt. From this perspective, this paper looks more closely at the following constructions:¹¹

⁷See also Lanno and Thomadakis (2019).

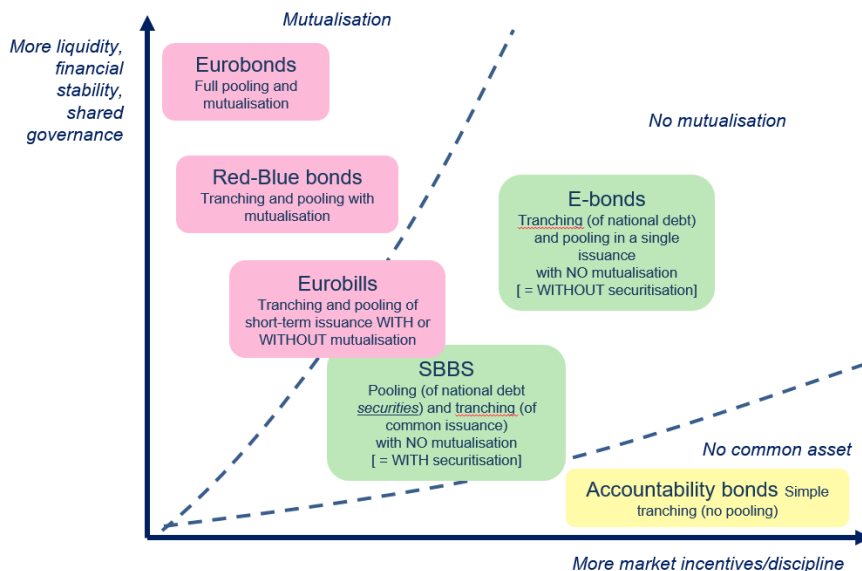
⁸See European Commission (2018b), which indicates that increasing the available pool of euro-denominated assets with high credit rating would contribute to developing the European financial sector and enhancing the global relevance of EU financial regulation and payment systems. See also Leonard et al. (2019) calling for a European safe asset to support the international role of the euro and as a basis for the Banking Union and the Capital Markets Union.

⁹See IMF (2012), Laeven (2014), Golec and Perotti (2017) and McCauley (2019).

¹⁰In Figure 1, while estimates by Zettelmeyer and Leandro (2018) suggest that in terms of possible volumes the SBBS and E-Bonds could be similar, their position on the vertical axis is different as E-bonds would entail a higher degree of shared governance given their reliance on a common issuer with a European institutional nature.

¹¹Other interesting approaches, which however would not create a fully-fledged safe asset, are:

Figure 1: Design options for a European safe asset



- *Sovereign bond-backed securities (SBBS)*, which would consist of pooling government bonds issued by euro area countries and tranching them into senior and junior securities. The feasibility of this proposal was studied in detail by the ESRB High-Level Task Force on Safe Assets (2018), based a
- *Accountability bonds*, which build on the concept of subordination of national debt to increase incentives for sound fiscal policies through market discipline but do not entail the creation of a common safe asset or provide a transition path towards it, and are therefore not considered in this paper. See Fuest and Heinemann (2017).
- *Purple bonds*, which is a proposal for a 20-year transition towards a mutualised safe asset (in the form of the Blue bond proposal referenced above). During this transition period, the amount of national sovereign debt consistent with the Fiscal Compact's annual commitment (to reduce the excess general government debt above 60% of GDP by 1/20 every year) would be labeled "Purple" and protected from debt restructuring under a possible ESM programme. Purple bonds are not considered in this paper as they do not directly entail the creation of a common safe asset and embed an element of mutualisation. At the same time, they could provide a path for debt reduction towards the 60% of GDP reference value which deserves consideration (including in combination with the introduction of E-bonds) if the goal is to advance towards some form of Fiscal Union, also not considered in this paper. See Smaghi and Marcussen (2018).
- *ECB deposit certificates*, which is a proposal that would see the ECB issuing tradable certificates backed by the assets on its balance sheet. While these certificates would be very safe, it would be difficult to deliver a continuous supply (it would rather be a one-off operation) and to issue them with longer-term maturities. They would affect the conduct of monetary policy and could exacerbate monetary dominance. However, they could perhaps be part of a transition process. See Tonveronachi (2018) and Sandbu (2019).

proposal by Brunnermeier et al. (2017) (hereafter “B-et-al”) to introduce European safe bonds (ESBies). In 2018, the European Commission proposed an enabling framework to remove unwarranted regulatory obstacles to the market-led development of SBBS.

- *E-bonds*, which would be issued by a public entity (a common issuer with a European institutional nature) who would pass on the funding amounts thus raised to Member States by granting them unconditional senior loans. The use of seniority, combined with a size cap, would render the E-bonds safe, resorting neither to securitisation, nor to mutualisation of debt (current or future), nor to joint guarantees. First proposed in Monti (2010),¹² they were featured under “Option 3” of European Commission (2011) as a model to support common issuance backed by several *but not joint* guarantees. They were more recently studied by Zettelmeyer and Leandro (2018) (hereafter “Z-L”), who come to the conclusion that E-Bonds have attractive features in terms of safety, liquidity and incentives, and that their potential size and attractiveness, as well as their impact on national bond markets, deserve careful investigation.¹³
- *Eurobills* (without mutualisation) can be described as a variant of the E-bonds model that would limit the maturity spectrum of the common issuance to short-term instruments. Eurobills, or E-bills, were first studied by an expert group chaired by Tumpel-Gugerell et al. (2014) and further developed by Bishop (2018). Leaving aside their mutualised forms (based on joint liabilities), in this paper E-bills are considered as a short-term (initial) sub-set of E-bonds, constructed in the same manner as those, based on the seniority of the loans from the common issuer to Member States. While E-bills alone would not generate a full common yield curve,¹⁴ as part of a broader process they could still deliver important benefits (see Section 7).

Contributions from this paper

This paper provides additional perspectives on the credit risk properties of national bonds, SBBS and E-bonds, based on a review and recalibration of the

¹²E-bonds were also proposed by the then prime minister of Luxembourg, Jean-Claude Juncker, and Italian minister of finance, Giulio Tremonti, in an op-ed in the Financial Times in 2010, although their proposal was at that time misinterpreted as embedding mutualisation, in the same way as Blue bonds. See Juncker and Tremonti (2010).

¹³Besides “Z-L”, also Bruegel recently advocated further research into the E-bonds model: “In our view, E-bonds have many desirable properties, including that they are issued by a true euro-area institution. But they raise the questions of whether the necessary contractual arrangements and seniority would be respected by all sovereigns and would be enforceable, and whether marginal funding costs would either become so expensive that fiscal stabilisation policy becomes severely constrained at the margin or whether, on the contrary, marginal funding would come down as rollover risks fall. The euro area should evaluate whether E-bonds would work as intended.” See Demertzis et al. (2019).

¹⁴As explained in Constâncio (2019), issuing only short term paper would not serve the panoply of important objectives sought from a European safe asset.

models and assumptions used in the literature, and in particular of the contributions by “B-et-al” and “Z-L” referenced earlier. The first part of the paper reviews and updates the underlying assumptions based on empirical evidence, including the full sample of available time series for credit default expectations. This leads to a choice of probabilities of default and losses given default that, while highly conservative, are more solidly grounded on the euro area’s historical experience, on actual data on sovereign credit events and on industry practice. Those assumptions are then used to recalculate the (average) credit risk properties of national bonds, SBBS and E-bonds that are used in the remainder of this paper.

The paper then assesses the potential volume of a common safe asset built using the SBBS or E-bond models. It shows that both models could reach significant size and argues that previous studies might have underestimated their potential.

The paper also advances a streamlined E-bond construction based on senior loans, a single issuance cap and the participation of national debt management offices in its governance structure. Credit risk simulations show that this streamlined E-bond construction could deliver (without mutualisation) a common safe asset with sufficient volume and a credit worthiness equal to, or even greater than, the current European benchmark, the German Bund. An additional advantage of this construction with a supranational common issuer is that it would provide legal certainty on seniority – essentially as it would not be possible for a Member State to change that aspect unilaterally.¹⁵

The paper also assesses quantitatively the impact of introducing E-bonds on the remaining national bonds which would continue to be issued in parallel.¹⁶ The results confirm that the introduction of E-bonds would, *ceteris paribus*, exert pressure on national bond yields. Such higher marginal funding costs would have an important effect in the context of the evolving architecture of EMU, as they would boost incentives for more prudent fiscal policies. At the same time, average funding costs should remain broadly unchanged, hence not impacting on Member States’ debt sustainability prospects. The paper shows that the potential size of the E-bond issuance would not be constrained so much by the credit risk of E-bonds themselves as by the wish to preserve the rating of current triple-A issuers, or to contain the increase in the marginal cost of funding for less creditworthy sovereigns. In particular, the increase on marginal costs should not be excessive as that may create difficulties in terms of primary market placement. Having this key concern in mind, the paper provides the elements for conducting a possible calibration of the size of E-bonds that balances various trade-offs in a prudent way.

To conclude, the paper illustrates the potential impact of creating a safe asset such as E-bonds on financial markets and considers possible general equi-

¹⁵This would apply to the legal aspect of seniority. The question of a Member State that decides not to respect such a legal obligation is discussed in Section 5.

¹⁶This exercise is relevant only for the E-bond model, as the risk transferred to the national bond depends directly on the size of the E-bond issuance. For SBBS, the degree of credit risk of the national bonds is unaffected by the size of the senior tranche of the SBBS.

librium effects and transition elements. A comparison with the outstanding volumes of debt securities issued by euro area countries shows that a relatively small issuance of E-bonds could achieve sufficient scale and safety – similar to those of Member States with the highest credit ratings – so as to become the asset of reference in the euro area. A comparison with the maturity pattern of US sovereign debt also shows the potential for making E-bonds the main government debt instrument in the euro area for maturities of less than two years. Based on the current sovereign exposures of banks, insurers and pension funds, conservative assumptions suggest that the introduction of E-bonds could deliver visible benefits in terms of reducing banks’ exposure to national sovereign risk and their degree of home bias.

2 Previous studies on the SBBS and E-bond proposals

Brunnermeier et al. (2017) featured an analysis of the credit risk properties of SBBS based on Monte Carlo simulations and a number of assumptions regarding expected losses, probabilities of default and losses given default. Successive exploratory work in this area has used this model and assumptions as reference, including the work of the ESRB high-level task force on SBBS and the papers by Zettelmeyer and Leandro, which used this simulation model as a basis for comparing SBBS with other constructions, including E-Bonds.

The aforementioned methodology for analysing the credit risk of collateralised sovereign debt obligations based on Monte Carlo simulations is based on a set of assumptions for:¹⁷

1. the probabilities of default (PD);
2. the losses given default (LGD);
3. how PDs and LGDs vary with three states of the economy, and
4. the probability of occurrence of those states (Prob).

Taken together, these parameters determine the expected losses for sovereign i , as per the following formula, which takes into account PDs and LGD rates over three states j of the business cycle:

$$EL_i = \sum_{j=1}^3 Prob_j \times PD_{i,j} \times LGD_{i,j} \quad (1)$$

Typically, analysts set a conventional value for the LGD, and use PD estimates to determine the expected loss and, hence, the insurance premium to cover it, as expressed by credit default swaps (CDS) spreads. “B-et-al” calibrate

¹⁷For convenience sake, in the following sections these assumptions are denoted as the “B-et-al” assumptions.

their parameters through the inverse operation, i.e., by taking CDS data as the basis for inferring expected losses and PDs, which are used in turn for carrying out simulations. The assumed LGD rates range from 20% for Germany to 95% for Greece depending on the state of the economy (see Appendix A, Table 7).

3 A reassessment of baseline sovereign credit risk

3.1 Using more solid (fuller evidence) assumptions

The risk parameters used in previous studies, specifically the PDs and LGDs for each state of the economy, are set in a relatively simple manner, being subject only to:

1. Monotonicity rules, according to which
 - i. higher PDs and LGDs correspond to worse states of the economy;
 - ii. within each state, higher PDs and higher LGDs correspond to lower observed credit ratings;
2. A degree of consistency between average expected losses¹⁸ (or, possibly, expected PDs) and sovereign CDS data observed in a particular month (December 2015).¹⁹

As will be discussed, more solid, empirically-grounded assumptions seem advisable for conducting an assessment of sovereign credit risks. While the static nature of the simulation model carries intrinsic limitations, including as regards the possibility of conducting point-in-time estimates, it provides an overall framework for carrying out the simulations which readily allows for comparisons with previous studies.²⁰

As concerns the assumptions to be used for our simulations, a number of questions appear pertinent. First, whether the choice of using December 2015 market data is appropriate to describe average sovereign credit risk in the euro area. Second, whether the breakdown of average PDs and ELs into expansion and recession scenarios (as well as the probability of these scenarios) is consistent with the available data for the euro area. A third question relates to the chosen LGD values, and whether they agree with the available evidence and industry practice. In the remainder of this section, we address these questions in turn.

¹⁸Here and elsewhere, we mean by average expected losses the weighted average of the expected losses in each state of the economy, as given by Equation 1.

¹⁹Consistency between average expected losses and sovereign CDS data applies only to the benchmark calibration. When using the adverse calibration to stress test the benchmark results, as in Appendix E, such consistency is lost.

²⁰See also Appendix A which replicates the inference of the risk parameters in “B-et-al”.

Sample period for CDS data and cyclical attributions

Previous studies relied on average expected losses inferred from sovereign CDS spreads for a single data point, i.e., December 2015. This data point was assumed to represent the central, or average, scenario, which is subsequently split into three different scenarios (i.e., an expansion, a mild recession and a severe recession) with different probabilities (respectively, 70%, 25% and 5%).

The general approach in this paper is to review the expected loss assumptions using the entire available data for the euro area, thus capturing different periods, including severe crises. Therefore, we (i) take the full sample of available CDS data for the euro area Member States,²¹ and (ii) use the Centre for Economic Policy Research (CEPR) business cycle chronology as a basis for classifying recessions and expansions.²²

To calculate average CDS spreads across the states of the economy, we rely on evidence on cyclical developments in the euro area. Euro area recessions in our sample correspond to those identified by the CEPR, namely the periods running from (i) the second quarter of 2008 through to the second quarter of 2009 and (ii) the fourth quarter of 2011 through to the first quarter of 2013 (see Figure 2). This corresponds to an average recession probability of 17% for the CEPR sample over the period since the inception of the euro area, i.e., from 1999 to 2015. The recession probability for an aggregate of euro area countries calculated based on the full available sample running from 1970 to 2015 is similar (16%).

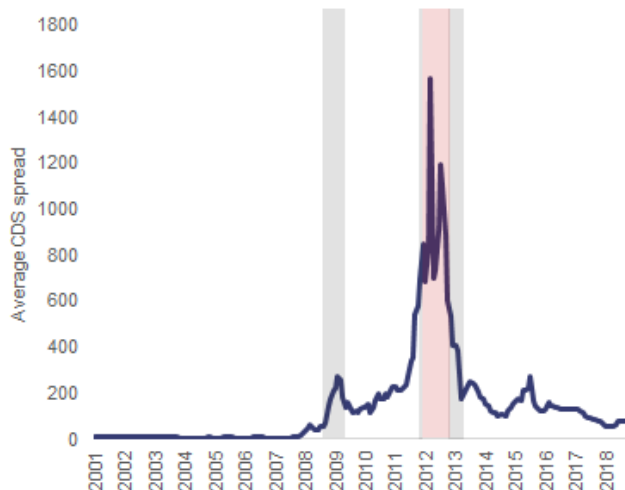
In line with the model structure, the recession periods are split into “mild” and “severe”. The severe recession is assumed to correspond to the 12 months from November 2011 to October 2012 which is the period when average CDS spreads are highest in the sample (in excess of 600 bps).²³ When considering the full CEPR sample, the length of the subsample thus identified is broadly in line with the “B-et-al” assumption according to which 1 in 6 recessions are deemed severe. In keeping with this assumption, we split the 17% probability

²¹The CDS data used in this paper are mainly taken from Bloomberg and are based on the ISDA 2014 definition, where available. For the sample start dates per country, see Table 1. As in “B-et-al”, data on 5-year CDS contracts was collected in order to infer sovereign PDs over a 5 year horizon. The Bloomberg CDS series, which run until November 2018, start no earlier than 2004 but are extended backwards where possible using Markit data. Our sample start dates thus range from 2001 to 2006, with the exception of Lithuania and Cyprus, which start in 2009 and 2012, respectively. Later starting dates imply a relative bias in the calculations, as the sample becomes more dominated by periods characterised by higher spreads. It should be noted that such a bias works to increase the conservatism of the simulations for some countries (in practice, those with smaller sovereign debt markets). Due to the absence of data, and as in “B-et-al”, the CDS spreads for Luxembourg are set equal to those of the Netherlands, a country with which it shares a AAA rating. Also due to the absence of data, the CDS spreads for Malta are set to the average of those for Estonia and Lithuania, an approach motivated by the fact that the credit ratings of Malta tended to evolve within the range of the ratings for those two countries during our sample period.

²²See <https://cepr.org/content/euro-area-business-cycle-dating-committee>.

²³As such, the term “severe recession” does not necessarily refer to the period when the decline in GDP was the greatest, but rather to the period when sovereign risk was perceived as highest, on average.

Figure 2: Euro area recessions and average sovereign CDS spreads



Note: shaded areas denote either a period of “mild” recession (grey) or of “severe” recession (red).

Source: CEPR, Bloomberg, Markit, own calculations.

of a recession into a 14% probability of a mild recession and 3% probability of a severe recession.²⁴

Table 1 shows that the simple, full-sample average of CDS spreads are generally much higher than those for December 2015 used in the benchmark calibration of previous studies, and that the latter are generally closer to the average spreads calculated for expansions (Greece constitutes a notable exception). This highlights the fact that the approach of this paper obeys a high degree of conservatism as regards each of the three phases of the cycle.

This is a result of the fact that:

1. the severe recession is based on the worst period of the worst crisis since the 1930s;
2. the mild recession covers periods of the Great Recession and of the euro area sovereign debt crisis when CDS spreads and sovereign bond yields reached unprecedentedly high levels;
3. the expansionary phase covers some post-crisis periods of strong market turbulence.

²⁴While the probabilities associated with the different states of the economy are less conservative in our simulations than those assumed by “B-et-al” based on data for the US, it will be presently seen that our re-run of the simulations is based on overall more conservative assumptions on average expected losses.

Table 1: Average sovereign CDS spreads

Member State	December 2015	Full sample average	Full sample cycle-weighted average	Severe recession	Mild recession	Expansion	Sample starts	Number of months
AT	22	39	38	151	91	25	07-2002	197
BE	32	49	73	230	273	34	02-2001	214
CY	250	508	369	1231	47	393	03-2012	81
DE	13	23	23	81	44	17	10-2002	194
EE	65	107	278	124	1529	73	02-2006	148
EL	1079	1173	767	11169	179	490	01-2001	213
ES	86	99	82	450	65	72	03-2001	213
FI	20	21	22	64	53	16	07-2002	197
FR	26	41	44	175	105	29	05-2002	199
IE	41	136	124	563	184	97	01-2003	191
IT	96	114	102	445	108	88	02-2001	214
LT	80	144	136	262	149	129	09-2009	111
LV	80	192	182	270	421	139	01-2006	152
LU	16	32	31	100	65	23	08-2003	166
MT	72	130	122	193	276	94	02-2006	148
NL	16	32	48	100	190	23	08-2003	166
PT	174	206	173	951	126	153	03-2002	201
SI	115	122	103	388	111	91	11-2004	155
SK	49	67	59	232	100	46	10-2004	170

Note: the sample ends in November 2018. Discrepancies between the sample start date and the number of months in the sample are due to the fact that, for some countries, CDS data is unavailable for some months.

Source: Bloomberg, Markit, own calculations.

It's also worth noting that, in some cases, CDS spreads are not monotone with respect to the overall state of the euro area economy, which is a consequence of the empirical fact that national and euro area-wide cycles are not perfectly synchronous.

Loss given default assumptions

As discussed earlier, the assumptions on both sovereigns' PDs and LGDs are crucial inputs to the credit risk simulations. In particular, once ELs have been inferred from CDS data, the assumptions on LGDs govern the assumptions on PDs, as per Equation 1 above.

It is clear from Equation 1 that, for a given EL, any bias in the LGD assumptions implies an offsetting bias in the PD assumptions. Accurate credit risk simulations thus require a careful choice of LGDs, which motivates a review of available evidence from (i) market conventions, (ii) the regulatory framework, (iii) banks' own estimations, (iv) historical sovereign default episodes and (v)

econometric methods.

The market convention for LGDs when pricing sovereign CDS contracts is 60%. For instance, Bloomberg’s street convention value for the recovery rate (RR) for sovereign CDS is 40%. Given that RR is the complement of the LGD, this means an LGD of 60%. IHS Markit, a provider of sovereign CDS data, also supplies analysts with series for sovereign RRs. Again, the modal value of the RR for euro area sovereigns is 40%, while deviations from this figure are found to be only sporadic and comparatively small.

As regards the EU regulatory framework, Article 161(1)(a) of the Capital Requirements Regulation sets a constant sovereign LGD of 45% for banks relying on regulator-provided LGDs under the “Foundation” Internal Ratings Based (IRB) approach to credit risk weight calculation. Similarly, banks’ own estimations can vary significantly, but average sovereign LGDs tend to be (well) below 60%, while estimates higher than this figure are comparatively rare. Bank-level data also suggests that there is no clear correlation between estimated PDs and LGDs. For a review of banks’ estimation of sovereign LGDs see Appendix B.

As regards historical default episodes, Moody’s (2017) provides an average issuer-weighted LGD of 46% for the 1983-2016 period, which rises to 70% on a value-weighted basis. Cruces and Trebesch (2013) construct a large dataset of sovereign defaults and find that, for the full sample of 180 sovereign debt restructurings between 1978 and 2010, the average haircut was 37% (simple mean) while the volume-weighted average haircut was lower, amounting to about 30%. They also find that the “Brady deals”, which put an end to the 1980s debt crisis for 17 debtor countries, involved a high average haircut of 45%. This exceeds the mean investor loss for the more recent subsample of 17 sovereign bond restructurings since 1998 (39%). The type of debtor also matters. In particular, they find average haircuts of 87% in restructurings of highly indebted poor countries. The average haircut in these 23 donor-supported restructurings is nearly three times as large as for restructurings in middle-income countries. One could expect that LGDs for vulnerable EA countries would be more comparable to the latter group, rather than to the former. Finally, the experience of one of the largest haircuts ever recorded in absolute value terms, the unique case of Greece’s private sector involvement in 2012, as analysed in Zettelmeyer et al. (2013), shows that even under most distressful economic, financial and fiscal conditions, the LGD is reckoned to have been approximately 65%.

As regards the inference of LGDs through econometric methods, Camba-Mendez and Serwa (2016) use latent factor models to disentangle PDs from LGDs based on the evolution of CDS spreads. Their results suggest that implicit sovereign LGDs generally remained well below 60% between 2008 and 2012, and, in all cases but one country, below 40%. Additionally, LGDs do not appear to co-move systematically with PDs, meaning that changes in sovereign credit risk translate essentially into changes in PDs.

Based on the previous review, it can be concluded that, while there is no clear evidence for time variation, or state dependency of expected LGDs, it is possible that they may mildly reflect debt levels and experience limited increases in periods of systemic stress (much larger variations taking place in terms of

PDs). Accordingly, it appears imprudent to assume very low LGDs for countries which, at a given point in time, are experiencing low CDS spreads. In addition, it can also be concluded that figures well above 60% for high income countries lack empirical plausibility, even in times of distress. In particular, LGDs in the range of 80% to 95% for some euro area countries in the severe recession scenario, appear unhinged from available evidence. At the same time, this implies a significant downward bias for inferred PDs.

In our credit risk simulations we therefore set an upper bound of 65% for the LGDs, while generally imposing more conservative lower bounds. An upper bound of 65% has the advantages of:

1. being appropriately conservative, reflecting the LGD of the Greek restructuring (a historically high haircut under particularly unfavourable circumstances) and deep within the right tail of the distribution of LGD estimates and realisations reviewed above, also taking account of the available evidence of past defaults in higher-income countries;
2. not being unreasonably large, so as to not skew inferred PDs and be incongruent with the available evidence on LGD estimates and realisations;
3. broadly agreeing with conventional LGDs used when pricing CDS contracts.

The LGD assumptions to be used in the simulations in this paper are shown in Table 2 below. To introduce an additional source of variability, as in other studies, LGDs in mild recessions are set equal to 80% of those in severe recessions. In the expansionary scenario, LGDs are set equal to 2/3 of the LGDs in a severe recession.²⁵

3.2 Recalculating baseline expected losses for euro area sovereigns

The final step involves recalculating the baseline sovereign expected losses underpinning the new simulations shown in Section 5. Figure 3 plots the new EL assumptions and compares them to the “B-et-al” assumptions.²⁶ The former are based on:

1. the new cycle identification and probabilities, based on CEPR data and discussed above (see Figure 2);
2. the new LGD assumptions presented in Table 2; and
3. the new PDs extracted from the full sample of available CDS data, on the basis of the new LGDs and the new cycles identified for the euro area.²⁷

Table 2: Alternative LGD assumptions

Member State	New assumptions				"B-et-al"
	LGD1	LGD2	LGD3	Average	Average
Germany	40	32	26,67	27,8	24
Netherlands	40	32	27	27,8	24
Luxembourg	40	32	27	27,8	24
Austria	45	36	30	31,3	27
Finland	45	36	30	31,3	27
France	60	48	40	41,7	36
Belgium	62,5	50	41,7	43,5	37,5
Estonia	65	52	43,3	45,2	40,5
Slovakia	65	52	43,3	45,2	42
Ireland	65	52	43,3	45,2	45
Latvia	65	52	43,3	45,2	45
Lithuania	65	52	43,3	45,2	45
Malta	65	52	43,3	45,2	46,8
Slovenia	65	52	43,3	45,2	48
Spain	65	52	43,3	45,2	48
Italy	65	52	43,3	45,2	48
Portugal	65	52	43,3	45,2	51
Cyprus	65	52	43,3	45,2	52,5
Greece	65	52	43,3	45,2	57

Source: own calculations.

Figure 3: Expected losses using fuller-evidence vs “B-et-al” assumptions



Source: Brunnermeier et al. (2017), Bloomberg, Markit, own calculations.

As can be observed, the expected losses in the *expansion scenario* resulting from the fuller-evidence assumptions are generally rather conservative as they are partly based on some post-crisis periods characterized simultaneously by euro-area wide expansions and strong market turbulence. Also, these assumptions lead to non-zero expected losses during expansions, even for the most creditworthy euro area countries and the pre-crisis period.²⁸

At the opposite end, in the *severe recession scenario*, the fuller-evidence assumptions produce less extreme results for the least creditworthy countries.²⁹ The picture is more mixed in the *mild recession scenario*. In this case, the

²⁵Overall, this leads to higher average LGDs for twelve countries and lower LGDs for seven countries, compared to “B-et-al”.

²⁶See also Appendix C for the exact figures.

²⁷As mentioned in Appendix A, in the absence of information on the original inference method in “B-et-al”, the 5-year PDs for sovereign i in month t were derived from average monthly CDS spreads using a simplified formula employed by practitioners according to which

$$PD_{i,t} = 1 - e^{(-T \times CDS_{i,t} / LGD_{i,t})}$$

where T represents the number of years of the CDS contract (i.e., 5). The expected losses shown in Figure 3 are then given by $EL_{i,t} = PD_{i,t} \times LGD_{i,t}$.

²⁸By contrast, the “B-et-al” assumptions imply zero 5-year expected losses for five Member States during expansions, and otherwise very low expected losses for several other countries.

²⁹To a lesser extent, the “B-et-al” assumptions also tend to be pessimistic for other Member States less severely affected by the crisis, with the notable exceptions of Austria, Germany, Luxembourg and the Netherlands.

expected losses resulting from the fuller-evidence assumptions may be either less or more favourable, compared with the previous studies.³⁰

The next sections of the paper rely on the recalculated sovereign credit risk to assess risk premia changes in government bond markets brought about by the issuance of a safe asset, whether on private initiative, as in the case of SBBS, or by a public entity, as in the case of E-bonds. But, before doing that, Section 4 elaborates on how E-bonds could be designed.³¹

4 A simple design for E-bonds

A possible European safe asset ought to comply with the existing legal framework of the TFEU, namely the non-mutualisation of national debt, also to gather sufficient political support. One option to achieve a sufficient degree of safety for the common safe asset while avoiding joint guarantees and risk mutualisation would be through the subordination of all national debt to the loans received from the common issuer of the European safe asset. Member States would use the received funds to replace existing debt. Subordination of national debt would only apply to debt issued after the launch of E-Bonds (grandfathering).

European Commission (2011) indicated that issuance backed by credit enhancements such as seniority of the issuer’s claims would be compatible with the EU Treaties. The compatibility of E-Bonds with the EU Treaties was also indirectly confirmed by the European Court of Justice in its “Pringle” judgment in 2012. In effect, under E-bonds, Member States would remain individually responsible for their commitments to their creditors and the conditions attached to the loans from the common issuer (i.e. the obligation to grant them seniority) should prompt Member States to implement sound budgetary policies.³² Should the European Stability Mechanism (ESM)³³ assume the role of the common issuer of E-bonds, it would neither be a guarantor of, nor assume the debts of, participating Member States.³⁴

³⁰In particular, the expected losses under “B-et-al” are noticeably more pessimistic for Greece, Portugal and Italy, but are markedly more optimistic for Estonia, Ireland, Latvia and Malta.

³¹The design of SBBS has already been carefully studied as regards its economic and legal aspects in ESRB High-Level Task Force on Safe Assets (2018) and in European Commission (2018a), including the accompanying impact assessment. Hence, this paper will not elaborate further on that construction.

³²According to paragraph 137 of the “Pringle” Judgment: “Article 125 TFEU does not prohibit the granting of financial assistance by one or more Member States to a Member State which remains responsible for its commitments to its creditors provided that the conditions attached to such assistance are such as to prompt that Member State to implement a sound budgetary policy.” See European Court of Justice (2012).

³³The common issuer could be e.g. the ESM, the EIB, the Commission or a new supranational entity. Savona (2019) suggested recently it should be the ESM.

³⁴According to European Court of Justice (2012), paragraph 138: “(...) the ESM will not act as guarantor of the debts of the recipient Member State. The latter will remain responsible to its creditors for its financial commitments.” Paragraph 139 adds: “The granting of financial assistance (...) in the form of loans (...) in no way implies that the ESM will assume the debts of the recipient Member State. On the contrary, such assistance amounts to the creation of

The seniority of the loans granted by the common issuer to Member States could be legally ensured in various (possibly complementary) forms, such as (i) an inter-governmental agreement, (ii) a specific “seniority” clause in the loan contract and (iii) a “subordination” clause in (new) national bond contracts.³⁵ The legal setup should be constructed to avoid the possibility of unilateral changes by any Member State, which would be achieved through the use of bilateral loan contracts mentioned under point (ii), and also by ensuring that the intergovernmental agreement and the loan contract are not under the national jurisdiction of that Member State. The specific legal details and operational features would need, however, further analysis.³⁶

The interest payments on the loans from the common issuer could be arranged either directly – Member States would pay interest directly to the common issuer – or indirectly through the EU budget. In the latter case, each Member State would pay an additional contribution to the EU budget to cover the interest that it owes on its loans and the EU would then transfer those amounts to the common issuer. In this manner, the credibility of interest-payment flows would benefit from the regularity of the established EU budgetary contribution process, complementing the seniority of the loans.^{37 38}

Total loans would represent approximately the same proportion of GDP for each Member State. Hence, total E-Bond issuance would approximately amount to that same proportion also in terms of overall euro area GDP.³⁹ In this respect, the model of E-bonds considered in this paper deviates somewhat from the simulations run by “Z-L”, which, for easier comparison with SBBS, apply a more complex “purchase rule” to keep portfolio weights close to the ECB capital key and to preserve a minimum volume of national issuance⁴⁰ even for countries

a new debt, owed to the ESM by that recipient Member State, which remains responsible for its commitments to its creditors in respect of its existing debts. It should be observed in that regard that (...) any financial assistance (...) must be repaid to the ESM by the recipient Member State and (...) the amount to be repaid is to include an appropriate margin.”

³⁵Applying subordination only to new bond issuances after a given date would avoid legal issues as concerns currently outstanding sovereign debt.

³⁶See Section 8 for a discussion on how to avoid potential losses in case a Member State does not respect its obligations towards the common issuer.

³⁷Member States’ contributions to the EU budget have never been missed since the creation of the European Union in 1958. It is to be noted that should available funds be insufficient to make a payment from the EU budget (in this case, to the common issuer), the Commission is empowered under EU legislation to collect the necessary cash from Member States, and to sanction any Member State that may be in arrears.

³⁸Another potential upside of this approach could arise if the interest paid by the common issuer were to be lower than the related interest payments by Member States to the EU budget - in this case consideration could be given to using the excess to fund other activities. This could create resources for a euro area budget, directly generated by a common initiative of euro area Member States.

³⁹Some smaller Member States currently have very low levels of debt meaning that maximum issuance under E-bonds could fall below the common threshold in those cases.

⁴⁰This is possible thanks to the different nature of the construction. Under the SBBS model, the issuer operates autonomously, purchasing debt securities on primary or secondary markets. It is therefore important to set purchase limits on the SBBS operator so that it does not disrupt (primary and secondary) markets and the activities of national debt management offices.

with a debt-to-GDP ratio below the target size of the E-bonds. However, in the case of E-bonds there is no need to preserve minimum national issuance and geographical diversification of the underlying bond portfolio plays less of a role in the credit quality of E-bonds, compared with SBBS. In particular, there seems to be no counter-indication to having low-debt countries issuing their entire debt through E-bonds, given these countries' low credit risk.⁴¹

In terms of governance, Member States would play a driving role in the common issuance of E-bonds. First, they would set the cap on the initial volume of E-bonds that may be issued and the main elements of the transition, as well as any further increases to that maximum volume, depending on the success of the scheme. These decisions would need to be taken at a high political level in view of their market and political impact. Second, for the issuance strategy and its operation, national debt management offices (DMOs) could play a central role as part of a board establishing the maturity profile, the ticket sizes and the schedule of issuances, having in mind the possible repercussions on the functioning of national bond markets and seeking ways to complement the European and national issuance strategies. Reflecting this governance and the public nature of this endeavour, the funding advantage enjoyed by the common issuer, from higher liquidity and lower credit risk premia, would be transferred to Member States, net of any agreed fees (as discussed in Section 8). Moreover, participation could be open to EU Member States outside the euro area, provided that they assume the exchange rate risk of borrowing in euros from the common issuer.

5 New simulation results for SBBS and E-Bonds

This section presents new simulation results for the SBBS and E-bond models of safe assets based on the recalculated assumptions.

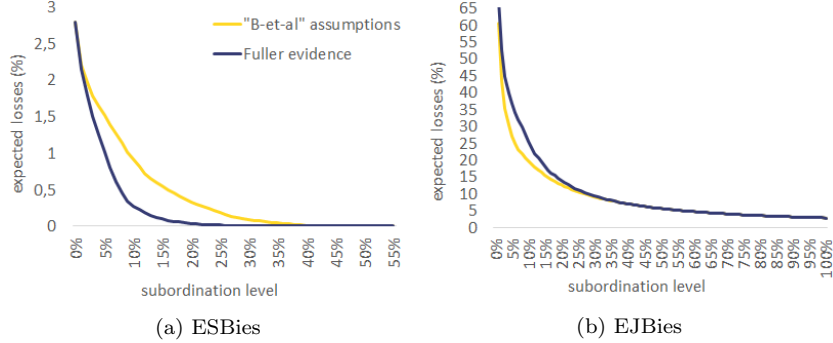
Sovereign bond-backed securities (SBBS)

We begin by focusing on senior and junior SBBS (ESBies and EJBies), comparing simulation results from using the original assumptions of the *benchmark* calibration of “B-et-al” and the fuller-evidence assumptions described in Section 3 of this paper.⁴² Figure 4 shows the expected losses on ESBies and EJBies based on the fuller-evidence and “B-et-al” assumptions, per subordination level and based on the original portfolio weights of “B-et-al”. As can be observed, ESBies are safer at all levels of subordination under the fuller-evidence assumptions

⁴¹Therefore, the lack of subordination enhancing the claim towards these countries should be largely irrelevant in the overall economy of the E-bonds. Moreover, E-bonds would eliminate the liquidity risks to which the holders of national bonds issued by small Member States with low debt levels are currently exposed.

⁴²In the benchmark calibration, the model relies on the PDs and LGDs discussed in Section 3, with cross-country correlations arising only from the common cyclical position. This scenario is subject to stress testing in Appendix E based on the adverse calibration. The latter leads to an increase in both PDs and cross-country correlations.

Figure 4: 5-year expected losses on ESBies and EJBies, per subordination level



Source: Own calculations.

when compared with the benchmark calibration of “B-et-al”. The difference springs from the more realistic LGDs and recession probabilities used in this paper, as well as from the fact that the original CDS data for December 2015 seem to produce an excessively pessimistic central scenario for some countries (e.g., Italy, Spain, Portugal and Greece) when compared with the full available sample of CDS data.

The risk profile of EJBies is similar under both set of assumptions for most subordination levels. However, for lower levels of subordination (below 25%), EJBies are reckoned as discernibly riskier under the fuller-evidence assumptions. This is due to the more conservative PDs, particularly for the most creditworthy sovereigns. Given that the proposal for SBBS envisaged by ESRB High-Level Task Force on Safe Assets (2018) involved an EJB tranche of 10% together with a mezzanine tranche of 20%, the 6 percentage points increase in the expected loss of EJBs at a 10% level of subordination under the fuller-evidence assumptions highlights possible unrecognised risks. Conversely, as regards the mezzanine tranche, expected losses are seen to drop from 3.8% to 1.2% under the fuller-evidence assumptions. It is worth noting that an expected loss on ESBies of less than 0.5%⁴³ can be reached with subordination levels as low as 8%. This is half the figure than that under the “B-et-al” assumptions, which required a subordination level of at least 16%. What is more, if the expected loss for Germany is taken as the safe-asset benchmark, then a subordination of 5% is enough for ESBies to reach a safe asset status under these simulations.⁴⁴

⁴³ “B-et-al” take 0.5% as the safety benchmark, a figure that corresponds to the expected loss for Germany under their adverse calibration.

⁴⁴ It should be noted that the full sample-based average expected loss for Germany stands at 1.06%, which is significantly higher than the 0.14% figure exogenously set in the original assumptions. The fact that the expected loss for Germany is estimated at 1.06% should be understood in relative terms, in comparison with the results for other countries, rather than as a definite measure of the average credit risk of Germany. In fact, this comparatively high figure is a consequence of a number of factors, including the influence of the crisis periods on

In the ESRB report, considering the need to preserve liquidity in national sovereign markets and to avoid disturbing the operations of DMOs, a size of € 1.5 trillion or more was identified for SBBS.⁴⁵ “Z-L” estimate a larger potential size and the calculations in this paper point in a similar direction. However, the schedule and homogeneity of senior SBBS depends on the demand for the junior securities, which may falter in periods of distress. A question that merits consideration is whether the size of the junior tranche and the implicit level of subordination may have to be larger than previously reckoned to avoid risks to the supply of senior SBBS in such times, which would lower the potential size of senior SBBS in practice.⁴⁶

Senior loans from a common issuer (E-bonds)

Turning now to an assessment of E-bonds, Figure 5 shows that, based on the *benchmark* scenario and the fuller-evidence assumptions, ELs for E-Bonds are negligible up to relatively high levels of GDP. These ELs are much lower for most volumes in percentage of GDP than those calculated in “Z-L”.⁴⁷ In particular,

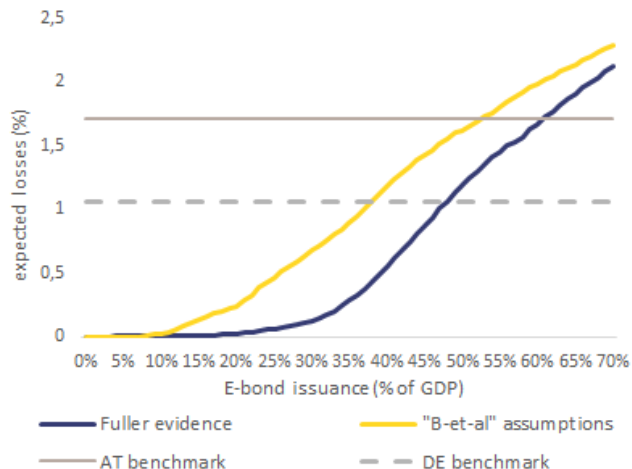
the sample and the simplified nature of the formulae used to derive PDs and ELs from CDS spreads.

⁴⁵As argued in ESRB High-Level Task Force on Safe Assets (2018), “given current volumes of outstanding debt, the maximum SBBS market size could be set at EUR 1.5 trillion or more, depending on liquidity conditions. With an issuer limit of 33%, for example, a reasonable steady-state size of the SBBS market would be EUR 1.5 trillion. (...) Although a higher issuer limit would allow the SBBS market to grow beyond this level, it might accentuate concerns regarding sovereign bond market liquidity, notwithstanding the positive spillover effects of greater SBBS market liquidity. An SBBS market of EUR 1.5 trillion is expected to have a limited negative impact on sovereign bond market liquidity.”

⁴⁶To prevent the junior tranche from becoming too risky, the composition of the underlying portfolio could be changed, excluding countries in or close to default. However, this could reduce the homogeneity (and liquidity) of both senior and junior SBBS. Moreover, any possible reduction or interruption in the issuance of the junior tranche (for instance due to insufficient demand in times of stress) would have the same effect on the issuance of the senior tranche, as both tranches are issued together. This could possibly undermine the markets’ perception of the senior tranche as a safe asset, for a truly European safe asset should be available in high quantities especially in periods of financial distress. For these reasons, European Commission (2017) presented the SBBS as an instrument to increase the supply of safe assets and promote diversification in banks’ balance sheets, while putting forward the European safe asset as a separate concept and as a medium-term policy option.

⁴⁷The E-bond scheme sizes presented in this subsection are based on issuance rules whereby Member States issue E-bonds up until a given percentage of GDP is reached, beyond which they are required to issue national bonds. The calculations assume that both government securities and central government loans can be potentially replaced by loans from the central issuer, and thus enter into the E-bonds scheme. The calculations also assume that these forms of debt can be subordinated to E-bonds. At the same time, non-central government loans are assumed to be neither replaceable nor subject to subordination. Given the different debt ratios of Member States (i) a common GDP-based issuance rule implies different levels of subordination for different countries and (ii) the implied E-bond portfolio weights are closely related to the GDP shares of participating Member States but may deviate from them as the E-bond issuance in some countries is capped by their low debt levels. In order to improve consistency with the underlying credit risk model, the implied subordination levels were calculated as weighted averages based on debt series covering the same time span and relying on the same cycle probabilities as for the CDS data described in Section 3.

Figure 5: 5-year expected losses on E-bonds



Source: Own calculations.

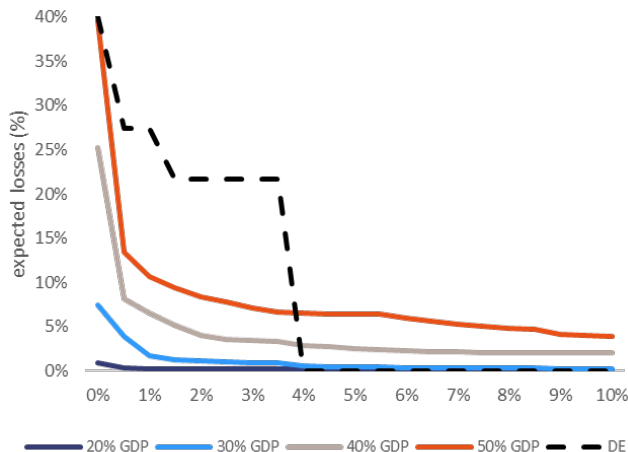
a 5-year expected loss below 0.5% can be enjoyed by E-bonds of a size of up to 39% of GDP. This is much higher than the 23% computed using the assumptions from previous studies.⁴⁸ In addition, using a safety level equal to the average historical ELs inferred for Germany as a reference, E-bonds would be safer than that benchmark for any issuance size up to approximately 47% of GDP. Alternatively, one can use as a threshold for a safe asset status the highest EL among Member States that either currently enjoy a AAA rating (Germany, the Netherlands and Luxembourg), or that have retained a AAA rating throughout most of the sample period used in the model calibration, while currently enjoying a AA+ rating (Austria and Finland). This latter benchmark corresponds to the EL for Austria (1.71%). Under the AT benchmark, issuance could be expanded to volumes up to 60% of GDP, indicating that E-bonds could enjoy a high degree of safety for total issuances amounting to high levels of euro area GDP.

Another important metric for assessing the riskiness of E-bonds is the value-at-risk (VaR), which considers the tail risks associated with particularly severe losses. Figure 6 displays the VaR of E-bonds for different issuance sizes, based on simulations using the fuller-evidence assumptions. As can be observed, when E-bond issuance corresponds to 20% of GDP, the VaR is negligible, even for very low quantiles (with the maximum loss estimated at less than 1%).

By increasing issuance size to 30% of GDP, the VaR remains generally very low, only rising noticeably when considering the far end of the loss distribution (the quantiles below 1%), but to contained levels, even in the case of an implausibly remote ("black-swan") systemic event whereby all euro area countries

⁴⁸The reasons for the difference in assessed expected losses are similar to those mentioned above when discussing ESBies.

Figure 6: Value-at-risk of E-bonds per issuance size



Note: solid lines represent the VaR of E-Bonds, for different scheme sizes. The dashed line represents the model-based VaR for Germany, for comparison purposes. The VaR for the 0% quantile represents the maximum possible losses. Based on the fuller-evidence assumptions.

Source: Own calculations.

default. It can be seen, furthermore, that the intrinsic diversification enjoyed by E-bonds allows the scheme to achieve lower tail risks than those implicit for Germany – one of the safest countries in our sample – even at volumes as high as 50% of GDP, when focusing on the lower quantiles of the loss distribution. Overall, the simulations under the fuller-evidence assumptions suggest that the tail risks of E-bonds are significantly lower than previously reckoned under the benchmark scenario. Appendix E presents stress tests for these simulations, which prove to be relatively robust.

6 Impact of E-Bond issuance on national bonds

Expected losses (ELs)

While the previous section showed that E-bonds would be extremely safe up to very large sizes in terms of euro area GDP, its design (based on seniority) is such that the larger its volume the stronger the pressure on the credit rating, price and liquidity of national bonds. This effect can constrain the level of common issuance that may be deemed acceptable and is analysed quantitatively in this section. Table 3 presents the expected losses of (remaining) national bonds for various levels of common E-bond issuance.

Before discussing the impact of E-bonds on national bonds, it is worth focus-

Table 3: Expected losses on national bonds (in %) per E-bond issuance size (as a % of GDP)

	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	1,1	1,2	1,3	1,5	1,7	2,0	2,4	3,1	3,7	3,7	3,7		
NL	1,4	1,5	1,7	2,0	2,3	2,8	3,5	4,5	4,8	4,8			
LU	1,4	2,2	4,5										
AT	1,7	1,8	2,0	2,2	2,4	2,6	3,0	3,4	3,9	4,5	5,2	5,2	5,2
FI	1,0	1,1	1,3	1,5	1,9	2,4	3,0	3,0	3,0				
FR	1,8	1,9	2,1	2,2	2,5	2,8	3,1	3,5	3,9	4,1	4,1	4,1	4,1
BE	2,1	2,3	2,4	2,6	2,7	3,0	3,2	3,5	3,7	4,1	4,4	4,7	4,7
EE	4,7	10,1											
SK	2,9	3,2	3,8	4,5	5,4	6,1	6,1	6,1	6,1				
IE	5,0	5,5	6,1	6,9	7,8	9,0	10,2	10,7	10,7	10,7	10,7		
LV	7,7	9,4	11,8	15,7	16,5								
LT	6,1	7,2	8,6	10,8	13,4	13,4	13,4						
MT	5,6	6,0	6,6	7,3	8,2	9,2	10,6	11,8	12,0	12,0	12,0	12,0	
SI	5,0	5,6	6,2	7,2	8,4	9,8	10,7	10,7	10,7	10,7			
ES	4,1	4,5	5,0	5,6	6,4	7,1	8,2	8,8	8,8	8,8	8,8	8,8	
IT	4,8	5,1	5,4	5,7	6,0	6,4	6,9	7,4	8,0	8,6	9,2	9,9	10,4
PT	7,3	7,8	8,3	8,9	9,6	10,4	11,4	12,4	13,9	15,2	15,6	15,6	15,6
CY	17,6	18,5	19,6	20,7	22,0	23,5	25,5	27,5	29,7	32,3	34,9	37,6	38,1
EL	15,4	16,0	16,5	17,3	18,1	19,0	19,7	20,8	22,0	23,3	24,3	25,8	27,5
E-bond		0,0	0,0	0,0	0,0	0,1	0,1	0,3	0,6	0,9	1,2	1,5	1,7

Note: based on the fuller-evidence assumptions; the last row shows the EL on E-bonds; a blank figure denotes a situation where the E-bond scheme size exceeds the amount of eligible sovereign debt outstanding as of year-end 2017, so that no national bonds are issued.

Source: Own calculations.

ing on the first column in Table 3, which shows the average ELs for individual Member States resulting from the fuller-evidence assumptions discussed in Section 3. ELs start from approximately 1% for the “safest” countries (Germany and Finland) and reach around 15-18% for Cyprus and Greece. Compared to the ELs in previous studies (see Appendix D), the ones presented in this paper are higher for the most creditworthy countries and, in some cases, lower for the less creditworthy ones.⁴⁹ As expected, Table Table 3 confirms that the credit risk of national bonds increases with the size of E-bonds.

Government funding costs

Given the characteristics of E-bonds, one should distinguish between the increase in the cost of government funding via national bonds, what would usually be “marginal funding costs”, and the “average funding costs”, which would be the weighted average of (i) the funding costs associated with national bonds, (ii) the costs on the loans received from the common issuer and, possibly, (iii) those on other forms of debt, such as borrowing by the non-central government. For simplicity, it is assumed that the interest rate charged by the common issuer on its loans to Member States would reflect the interest rate paid (on average) by this institution on its E-bonds.

Table 4 computes these costs using the model and assumptions described in previous sections. The last row of the table presents the risk premia that E-bonds would command for different sizes of common issuance. It shows that for issuances up to 15-20% of GDP, E-bonds would be basically riskless and pay no risk premium. This premium would only marginally increase afterwards and reach the average risk premium implied for German debt (21 bps) only when the E-bond issuance reaches 45-50% of GDP.

⁴⁹It should be noted that, as expected losses are generally higher in our simulations, the safety benchmark (corresponding to the expected losses on the bonds for Germany, the Netherlands, Luxembourg or Austria which enjoy(ed) a AAA rating in our sample) has also been shifted upwards compared to “B-et-al”.

Table 4: Increase in credit risk premia of national bonds (in bps) per E-bond issuance size (as a % of GDP of the euro area and each Member State)

	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	21	+2	+5	+8	+12	+19	+27	+40	+52	+52	+52		
NL	28	+3	+7	+12	+19	+29	+43	+63	+68	+68			
LU	28	+16	+63										
AT	34	+3	+6	+9	+13	+18	+25	+33	+43	+56	+70	+70	+70
FI	19	+3	+6	+11	+18	+29	+40	+40	+40				
FR	35	+3	+6	+9	+14	+20	+26	+34	+42	+46	+46	+46	+46
BE	43	+3	+5	+9	+12	+17	+21	+27	+32	+40	+46	+51	+51
EE	94	+107											
SK	57	+8	+18	+32	+50	+64	+64	+64	+64				
IE	101	+10	+22	+37	+56	+79	+104	+113	+113	+113	+113		
LV	154	+34	+83	+159	+177								
LT	122	+22	+50	+94	+147	+147	+147						
MT	111	+10	+21	+35	+52	+73	+101	+126	+128	+128	+128	+128	
SI	100	+11	+25	+45	+68	+97	+115	+115	+115	+115			
ES	83	+8	+17	+29	+45	+60	+81	+93	+93	+93	+93	+93	
IT	97	+5	+11	+17	+24	+32	+41	+52	+63	+76	+88	+102	+110
PT	146	+9	+20	+32	+46	+63	+82	+102	+131	+158	+167	+167	+167
CY	352	+19	+39	+62	+88	+117	+158	+198	+241	+293	+345	+401	+409
EL	308	+13	+23	+38	+54	+72	+87	+108	+132	+159	+179	+208	+241
E-bond		0	0	0	0	1	3	6	11	17	24	29	34

Note: based on the fuller evidence assumptions; the first column shows the national (average) credit risk premia in the absence of E-bonds; the last row shows the (average) credit risk premia on E-bonds; a blank figure denotes a situation where the E-bond scheme size exceeds the amount of eligible sovereign debt as of year-end 2017, so that no national bonds are issued.

Source: Own calculations.

Table 4 also shows the estimated increase in the risk premia of national bonds for various sizes of E-bond issuance, compared to their average credit risk under the current situation where no E-bonds are issued.⁵⁰ To do so, it first identifies the average credit risk premia that a country would pay on the junior debt that it issues directly, measured with respect to the risk-free rate and based on the full CDS sample period. This is reported in the first the column, “0% (no E-bonds)”. At 40% of GDP – and taking the “static” and “average” risk premia view of the simulation model – several countries would see their premia increase to more than 100 bps (and by almost 250 bps, in the case of Cyprus). For larger E-bond volumes, the simulations show that the situation on national bond markets could become rather challenging for a number of Member States. By contrast, with common issuance at 15-20% of GDP, spreads would increase only moderately. The increase in marginal cost of funding would be within a few dozen bps and, in any case, below 100 bps for most countries (with only Latvia and Lithuania experiencing higher rates as subordinated national debt would be very thin).

However, while subordinating national bonds to E-bonds would increase the marginal funding costs of sovereigns, as shown in Table 4, this would be mostly offset by lower interest rates paid on the senior loans. Table 5 shows the average credit risk premia paid by euro area countries on all of their outstanding debt.⁵¹ It indicates that, for an E-bond issuance worth 15-20% GDP, nearly all countries would pay on average the same funding costs as currently, with some low debt countries paying noticeably less.⁵² Most countries with lower ratings would pay on average less than now to fund their debt. However, as seen in Table 4, this would be accompanied by additional market pressure, as the marginal cost of issuing national bonds would be higher.

⁵⁰The change in risk premia was calculated based on a simplified, risk-neutral formula, according to which $\Delta CDS\ spread = \frac{\Delta EL}{T}$. Average credit risk is determined by the average expected losses calibrated under the recalculated assumptions, as reported in Appendix C.

⁵¹For countries with low debt levels, the average credit risk premia would quickly diminish and converge to the risk premia paid by E-bonds, as they would increasingly and then fully fund themselves via the common issuer. For countries with low debt, say as low as 20% like Luxembourg, the premia goes down to zero, and then increases slightly as larger E-bond issuances carry an additional risk; this occurs notwithstanding the fact that the amount of loans granted by the common issuer does not change (e.g., it corresponds to the totality of the Luxembourgian debt).

⁵²For countries with low levels of debt, the average credit risk premia presented in Table 5 fall very significantly with the introduction of E-bonds. This is due to E-bonds funding a large proportion of their total government debt and carrying much lower credit risk than national sovereign bonds. The fall in funding costs is the largest when the volume of E-bonds reaches the total volume of national debt (e.g.: for EE from 5% of GDP, LU from 10%, LV from 20%, and LT from 30%). However, for larger volumes of E-bonds, this funding advantage would be partly offset, as E-bonds would start to carry more risk. In terms of incentives for responsible fiscal behaviours, the cost of funding an extra euro of debt would be very low for these countries, as long as their total volume of debt remains below the E-Bond threshold. However, it would rise significantly (see Table 4) if the country would issue that extra euro of debt directly in the market, given subordination. This threshold effects could be seen as a strong commitment device to contain fiscal deficits and avoid increasing debt, with a “lock-in” effect once the country reduces the debt to lower levels in % of GDP than the size of E-Bonds issuance.

Table 5: Changes in average credit risk premia on total government debt (in bps) per E-bond issuance size (as a % of GDP of the euro area and each Member State)

	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	21	0	0	0	0	1	1	3	5	4	5	7	10
NL	28	0	0	0	0	1	1	2	-1	-3	-3	1	5
LU	28	0	-1	-25	-25	-24	-23	-20	-15	-9	-3	1	5
AT	34	0	0	0	0	0	1	3	6	10	13	11	10
FI	19	0	0	0	0	1	0	-4	-5	-2	4	8	12
FR	35	0	0	0	0	1	1	2	4	5	4	5	5
BE	43	0	0	0	0	0	1	2	4	7	9	10	10
EE	94	-60	-68	-68	-68	-67	-66	-64	-60	-55	-51	-47	-44
SK	57	0	0	0	-1	-7	-20	-31	-40	-38	-32	-27	-23
IE	101	0	0	0	0	-2	-5	-17	-30	-42	-52	-64	-60
LV	154	1	0	-5	-49	-139	-137	-135	-130	-124	-118	-113	-109
LT	122	1	0	0	-9	-46	-81	-110	-105	-99	-93	-87	-83
MT	111	0	0	0	0	0	0	-4	-18	-31	-43	-55	-76
SI	100	0	0	1	0	-3	-14	-33	-50	-64	-74	-69	-65
ES	83	0	0	0	0	-1	-3	-10	-20	-28	-36	-43	-45
IT	97	0	0	0	0	1	1	2	4	6	7	9	7
PT	146	0	0	0	0	0	0	-1	2	2	-7	-19	-32
CY	352	0	-1	-1	-2	-2	3	3	3	5	1	-5	-34
EL	308	1	-2	-1	0	2	-1	1	4	8	6	8	11

Note: average credit risk premia on total government debt is the weighted average of the premia paid indirectly on E-bonds issuance (via the senior loan) and of the premia paid on the remaining national debt (the junior part of which is show in Table 4). The first column shows the national (average) credit risk premia in the absence of E-bonds. The columns show the average cost for the totality of outstanding debt of a country for a given E-bonds issuance threshold. Risk premia on ineligible debt (i.e., non-central government loans) is assumed not to change with respect to the situation of no E-bonds.

Source: Own calculations.

With an E-bond issuance of 40% of GDP, Germany, France and Italy would see their average funding costs increase slightly, with many countries in the middle range of the creditworthiness scale seeing important reductions, implying some redistribution in favour of smaller Member States. At the same time, with such a sizable E-bonds scheme, the potential for significant macroeconomic benefits is also larger. On the whole, Tables 4 and 5 provide reassurance on the viability of issuing E-bonds for an amount of 15-20% of GDP and an indication of the trade-offs involved for larger sizes.

Overall supply of highly safe assets in the euro area

The impact on the creditworthiness of national bonds is relevant for identifying the changes in the overall supply of safe assets in the euro area. The total supply of safe assets (highly rated sovereign and supranational debt securities) depends not only on the volume of E-bonds but also on the evolution of the credit risk of national bonds, which would rise. In Figure 7, a horizontal line indicates the current volume of AAA-rated sovereign bonds in the euro area (circa € 1.9 trillion outstanding issued by Germany, the Netherlands and Luxembourg). This amount is compared with the overall volume of AAA assets that could be achieved by adding up the volume of E-bonds and national bonds that would remain highly safe. These are the countries whose expected loss remains below a threshold indicating AAA safety, which is set to the expected loss for Austria.⁵³

As mentioned, the credit risk of currently-rated AAA bonds would increase with the E-bond size and the related subordination of national debt. As can be observed also in Figure 7, for an E-bond issuance equivalent to 15% of GDP, the pool of assets considered safe in the euro area would increase to approximately € 2.7 trillion, which represents a 44% increase with respect to the current outstanding amount. At 20% of GDP, this figure rises to approximately 3.1 trillion, or a 64% increase. However, as E-bonds grow larger than 20% of GDP, German bonds may lose their AAA-rating, which explains the marked drop in AAA assets observed in the chart.⁵⁴

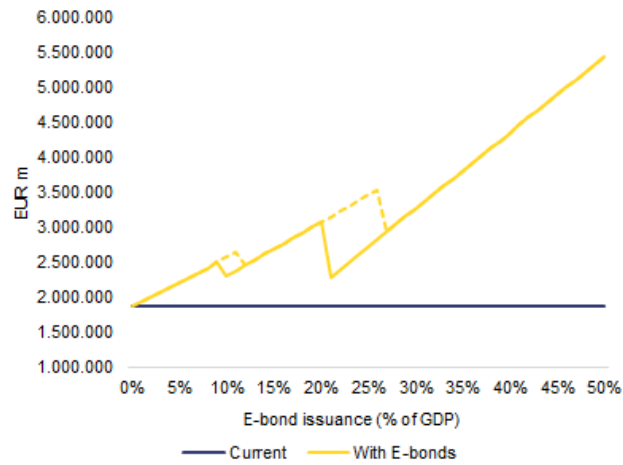
Further increases in E-bond issuance would “extract” and centralise safety from all other national bonds and central government debt, while also rendering the latter more liquid via E-bond issuance. This would offset the drop from the loss of AAA status of the Bund, and then push the safe asset pool to even larger sizes.⁵⁵ It remains to be seen if general equilibrium effects could avoid the kink around 20% of GDP, and allow German bonds to remain AAA-rated

⁵³As previously mentioned, it should be noted that Austria, a modest player in the euro area sovereign debt market, retained a AAA rating throughout most of the sample period used for calibrating our model.

⁵⁴A smaller kink can be observed at a common issuance of around 10% of GDP as the credit risk for Dutch and Luxembourgian bonds pass the AAA safety threshold.

⁵⁵“Z-L” look at the possible rating implications for the whole set of countries. A similar exercise in this context would require re-basing the reference EL threshold for levels other than AAA. It can be assumed however that shift in rating category would happen similarly to those indicated in “Z-L”.

Figure 7: Safe asset volumes per E-bond issuance size



Note: current amounts based on AAA sovereign bonds as of year-end 2017 (that is, issued by Germany, the Netherlands and Luxembourg); amounts under E-bonds are based on Austria's EL threshold; the dashed line shows the maximum achievable amount if all remaining national debt can be subordinated to the loans from the central issuer.

Source: Own calculations.

(see Section 9).⁵⁶

This analysis shows a broadly linear increase in the supply of safe assets in the euro area as E-bond issuance is raised to at least 20% of GDP. As will be discussed in the next section, E-bond amounts in the range of 15% to 20% of GDP should be sufficient to render it a very relevant, if not the main, asset in euro area financial markets. Going beyond that volume seems entirely possible, but the scope for doing so would depend not so much on the creditworthiness of German bonds, which would remain high in any case, but on the possible impact on more vulnerable countries.

With common issuance at 15-20% of GDP, the expected losses on the remaining debt of high debt countries would increase relatively little. This is because subordination levels remain very high, meaning that the credit risk shifted away to the senior claim is spread over a large base of remaining national bonds. For countries with low or modest levels of national debt, ELs can instead increase quite rapidly, as risks concentrate on a thin slice of debt. The impacts on risk premia and overall funding costs are discussed below. Needless to say, these calculations do not take explicitly into account the overall risk reduction from introducing a common safe asset in the euro area, which is expected to have a beneficial impact on the overall credit worthiness of all participating countries.

For a common issuance on the higher side of a plausible range, i.e., at 40% of GDP, Table 3 shows that several countries may no longer need to issue national debt securities (e.g., Luxembourg and the three Baltic countries). For others, the increase in “marginal” credit risk could become substantial.

7 Analysis of volumes, maturities and holdings

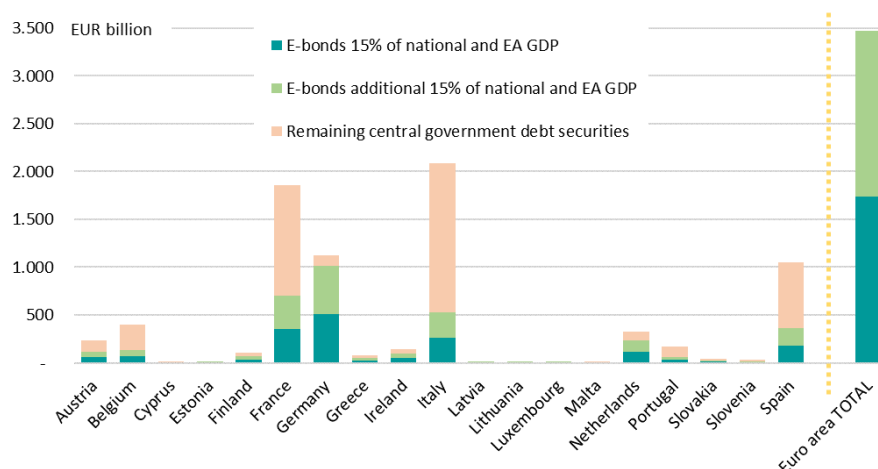
The simulations in the previous sections suggest that prudent levels of common issuance through E-Bonds, in the range of 15% to 30% of GDP, would carry very low credit risk, and hardly impact average funding costs of Member States, while having a limited effect on the marginal cost of funding, thus improving incentives for prudent fiscal policies. This section puts this issuance size into perspective, compared to the volumes of remaining national bond markets and to the current sovereign exposures of banks, insurers and occupational pensions funds.

Replacement of national markets

As mentioned earlier, the E-bond issuer would grant loans to Member States up to a pre-defined limit, expressed as the same percentage of GDP for all Member States (see Figure 8). In other words, if the maximum volume of E-bond issuance

⁵⁶In addition, if the whole of government debt (rather than only securities and central government loans) could be made subordinated to E-bonds, this kink would be avoided at 20% of GDP (and encountered at higher values). In addition, given the experience of the US, which do not enjoy a AAA rating from all main credit rating agencies, it is questionable whether the kink would actually materialise in such terms.

Figure 8: Replacement of central government debt securities by E-bonds across Member States



Note: based on the existing stock of listed central government debt securities issued by euro area Member States as at early 2019.

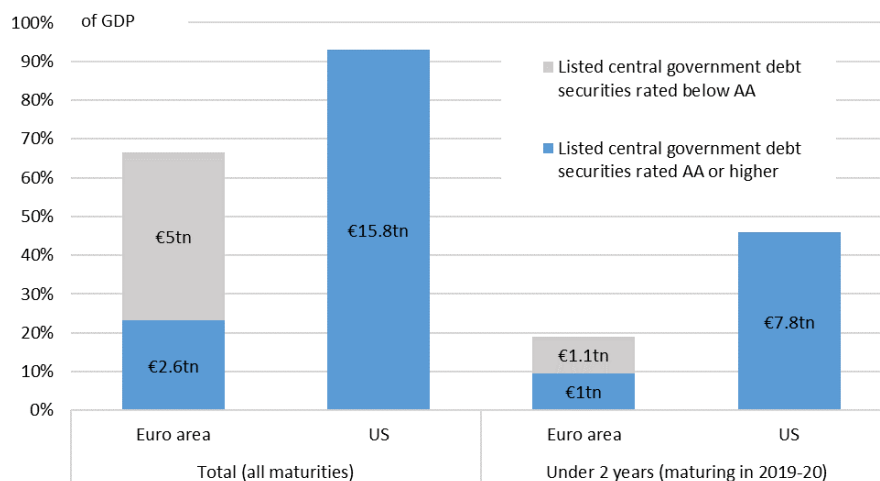
Source: Own calculations based on Bloomberg data.

is set at 15% of euro area GDP, each and every Member State would be able to receive funding from the common issuer up to a maximum 15% of their GDP. This means that (i) the lower the GDP of any given Member State, the lower the absolute amount of funding accessible to it through the E bond Issuer and (ii) the larger the stock of national debt, the higher the coefficient of subordination.

As a result, a large market for the common safe asset would gradually develop and reduce national markets accordingly. In the case of Member States with low debt levels debt issuance would be made exclusively through the common issuer.⁵⁷ Using recent data on listed debt securities issued by the central governments of euro area countries, an E-bond issuance amounting to 15% of euro area GDP would deliver a common safe asset of approximately € 1.7 trillion, already 54% larger than the current stock of listed debt securities issued by the German federal government (approximately 1.1 trillion).

⁵⁷Hence, there is an incentive for Member States with small debt levels to shift all or most of their funding operations to the common issuer, provided their debt remains within the general debt-to-GDP cap applying to all Member States. For some smaller countries, which may find that their debt levels slightly exceed the common threshold, it is already the case that they are facing liquidity issues on primary markets. They would likely make recourse to national issuance in only a few occasions (and for specific maturities which carry the most attractive funding costs), to reach the minimum ticket size.

Figure 9: Short-term and longer-term government debt securities in the euro area and the US



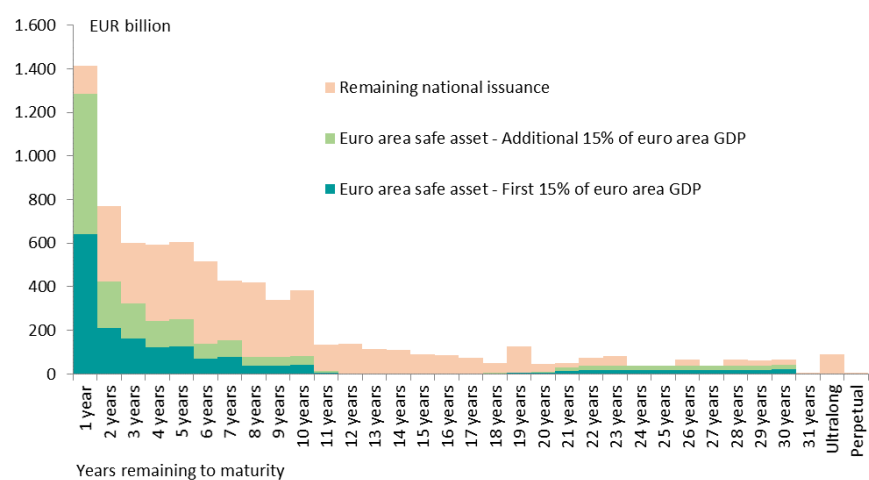
Source: Own calculations based on Bloomberg data.

Choice of maturity pattern and market impact

When exploring the possible maturity profile of E-bond issuance, it is useful to consider the existing profiles of potential participating countries and compare them to relevant benchmarks such as the US (Figure 9 and Figure 10). US federal government debt is much more skewed towards short-term maturities compared with euro area countries. This may reflect a lower rollover risk faced by the US federal government thanks to the role of lender of last resort or backstop function performed by the Federal Reserve.⁵⁸ E-bonds could perhaps enjoy a similar backing from the ECB so their issuance could be skewed towards short-term maturities — both in the transition phase, as a way to launch the programme of common issuance, and in the steady state. Such a maturity profile for E-bonds would respond to the motivation that led to the Eurobills proposal. Combined with the issuance of longer term bonds, this would allow the formation of a full euro area yield curve, which the Eurobills proposal did not envisage.

⁵⁸In the US, the Federal Reserve is seen by markets as a backstop or purchaser of last resort in the market for US Treasuries. However, in the euro area, countries can no longer rely on their own central bank to ultimately assist them in case of liquidity stress in the market for sovereign bonds denominated in their own currency. Issuer limits and different collateral haircuts apply to the provision of central bank liquidity to respect the prohibition of monetary financing and to manage credit risk. The introduction of a euro area safe asset with a supranational nature could help to overcome these limitations and enable a possible role for the ECB as a lender of last resort via such an asset. See, for instance, Cœuré (2016), Constâncio (2019), Constâncio (2018) and Grauwe (2011).

Figure 10: Implied maturity pattern of E-bonds, replicating the US federal debt profile



Note: the maturity distribution of US federal debt instruments is taken as a benchmark to simulate the potential maturity distribution of E-bonds, based on the existing stock of listed central government debt securities issued by euro area Member States as at early 2019.

Source: Own calculations based on Bloomberg data.

In effect, issuing at shorter maturities could be attractive for many DMOs, as national short-term markets are frequently too small and therefore entail higher costs for issuers (this has become particularly the case in some Member states given the lengthening of average maturities of sovereign bonds carried out following the crisis).⁵⁹ E-bonds focused on short-term maturities (E-bills) could create a new, liquid market that could reduce debt placement costs in primary markets. In addition, it is likely that E-bonds with short maturities would satisfy unmet demand by foreign reserve managers and corporations.⁶⁰

Equally, E-bonds skewed towards short-term maturities could become the instrument of choice by banks for liquidity and collateral purposes, helping to break the bank-sovereign nexus. Moreover, their political economy would be more manageable, as differences in yields across Member States are usually smaller for short-term maturities and the legal seniority of E-bonds would have a lower market impact. This is because short-term liabilities, now towards the common issuer, already have a chronological repayment priority over longer-dated paper. At the same time, compared to issuing E-bills alone, issuing longer-dated E-bonds would allow the creation of a full yield curve for the euro area, with potential advantages.

Holdings of banks and other financial intermediaries

The previous sections have assessed the potential size of E-bond issuance, its impact on national bond markets and the possible distribution of maturities taking the US as a benchmark. The key takeaways are that issuance of E-bonds of some 15-30% of GDP would be possible, that yields on national bonds would rise, and that E-bonds could cover most of the short-term financing needs of Member States. The next few paragraphs sketch out, in a partial equilibrium framework, how this issuance could be absorbed within the financial system and how that could impact the current concentration of risk from holding national bonds.

Table 6 presents a simplified assessment of the possible reallocation effects of introducing E-bonds on the composition of the sovereign exposures of banks, insurers and occupational pension funds. It is based on a total volume of E-bonds outstanding of 15% of GDP (the lower bound of the 15-30% range considered more easily implementable), which corresponds to about € 1.7 trillion of E-bonds. At the same time, the same amount of national bonds would no longer be on the market. Assuming that banks, insurers and pension funds would acquire all those E-bonds put in circulation, replacing their national holdings which have matured, this would correspond to a reduction of 36% in their exposures to national sovereigns.

If banks were to hold 36% of their sovereign exposures in E-bonds and keep the geographical distribution of their remaining (now lower) exposures to na-

⁵⁹See OECD (2019) and Association for Financial Markets in Europe (2017).

⁶⁰See the survey in OMFIF (2019) covering global public investors, who expressed their wish to buy more European safe assets and their interest in exploring the potential of a highly-liquid common euro area safe asset.

Table 6: Possible reduction in domestic sovereign exposures and home bias following the introduction of E-bonds

Euro area € million			Banks		Insurers and occupational pension funds	
Unchanged	Total assets	(1)	30.875.774		9.195.773	
	Total sovereign exposures to EA sovereigns	(2)	2.448.552		2.420.213	
	Total sovereign exposures over total assets	(2) / (1)	8%		26%	
Current	Domestic sovereign exposures	(3)	1.780.214		1.459.070	
	Domestic sovereign exposures over total assets	(3) / (1)	5,8%		16%	
Possible reallocation with E-bonds			Scenario 1	Scenario 2	Scenario 1	Scenario 2
	Assumed exposure to E-bonds over total sovereign exposures (*)	(4)	36%	65%	36%	10%
	Exposure to E-bonds	(4) * (2)	880.936	1.588.486	870.740	242.021
	Other sovereign exposures (to national sovereign bonds)	[A] = (2) - (4)	1,567,616	860,066	1.549.473	2.178.192
	Assumed home bias in other sovereign exposures (**)	(5)	73%		60%	
	Domestic sovereign exposures	[B] = (5) * [A]	1,139,732	625,309	934.128	1.313.163
	Domestic sovereign exposures over total assets	[B] / (1)	3.7%	2.0%	10%	14%

Note: (*) a simplified financial system is assumed, where the total supply of E-bonds, equivalent to 15% of euro area GDP, is entirely absorbed by banks, insurers and occupational pension funds; (**) remaining domestic national sovereign exposures over other sovereign exposures, chosen to be equal to the current ratio of domestic sovereign exposures over total sovereign exposures, expressed by (3)/(2) in the table - in other words, it is assumed that the home bias in national (i.e. non-E-bond) sovereign exposures does not change compared to the current situation; data on domestic sovereign exposures was scaled up from a large, representative EBA sample, for consistency with MFI aggregates.

Source: Own calculations, European Banking Authority, European Insurance and Occupational Pensions Authority and ECB. Bank and insurance data refers to Q3-2018. Occupational-pensions data refers to 2017.

tional bonds unchanged (Scenario 1 in Table 6), domestic exposures would mechanically go down as a share of total assets, from their current 5.8% to 3.7%. However, given the maturity mismatches inherent in their business model, banks may prefer to hold a relatively larger share of their portfolios in E-Bonds, given their liquidity, short term maturities and properties as collateral.⁶¹ For instance, if banks were to end up holding 65% of their sovereign exposures in E-bonds, their domestic exposures as a share of total assets would go further down to 2% (Scenario 2).

An even stronger preference of the banking sector for E-Bonds would release a larger share of national bonds onto the market, available to other investors. These assets, with relatively longer maturities and higher returns, but still much safer than equities, may attract the interest of life insurers and pension funds looking for more attractive risk-adjusted returns over longer periods of time to meet their liabilities.⁶² Scenario 2 in Table 6 assumes that insurers and occupational pension funds would hold only 10% of their sovereign exposures in E-bonds, and have the vast majority of their sovereign portfolio invested in national sovereign bonds. This would still make their domestic exposures as a share of total assets go down from 16% to 14%.

Overall, with the introduction of E-Bonds amounting to 15% of GDP, the sovereign home bias of banks, insurers and pensions funds could be significantly reduced. Importantly, this may happen without regulatory changes, assuming preferences are aligned as described above. At the same time, the reduction in home bias could be even stronger if banks would prefer to reduce their holdings of domestic sovereign bonds more than non-domestic ones, which would be the case in a more pan-European banking system, or with a policy or regulatory nudge. In any event, the introduction of a European safe asset with the consequent reduction in overall national sovereign exposures, would make it easier to implement possible regulatory changes, for example to avoid excessive concentrations in the (few) banks where sovereign home bias might remain an issue.

This partial analysis, which is presented for illustrative purposes, does not consider fully the investment preferences of the different financial institutions, nor possible shifts in demand that may take place not only within the euro area but also internationally. It does reveal, however, the absorption potential for safe

⁶¹The current demand for “level 1” high-quality liquid assets (HQLA) for compliance with regulatory requirements is estimated at approximately € 2 trillion for euro area banks, which should be compared to the € 1.4 trillion which would be their holdings of E-Bonds under the Scenario 2 in Table 6. Of the current demand for HQLA, approximately 40% can be met with lower liquidity “level 2” assets. The remaining 60% has to be met with “level 1” assets such as sovereign bonds, which is equivalent to approximately € 2 trillion. Estimation derived using ECB data. As no data for Germany is available, the average ratio of a HQLA over total assets ratio observed for similar countries (i.e., a ratio of 15%) is used.

⁶²There are arguments for why life insurers and pension funds could be expected to hold significant amounts of higher yielding subordinated national bonds, as these institutions have less leverage than the banking system, are more insulated from the short-term effects of price volatility due to their hold-to-maturity strategies and their exposure to possible liquidity outflows is significantly lower due to asset-liability matching, compared to possible runs in the banking sector.

assets and implications for holdings across different types of investors. Further work is needed to ascertain the possible implications for investors' demand.

8 Transition, extreme cases and incentives for sound policies

Dealing with the transition

An important issue to consider is the transition to the new regime, with E-bonds issued in the presence of legacy national bonds. To preserve current bondholders' portfolios and avoid unsettling markets, existing bonds should be grandfathered, meaning that subordination would only apply to newly-issued bonds. Also, the implied subordination rate for each country would be kept constant during the transition.⁶³ In practice, the target volume of E-bonds (the same for all Member States, expressed as a share of GDP) would translate into country-specific subordination rates. Taking Germany as an example, a target volume of E-bonds of 15% of GDP would correspond to subordination rate of roughly 72%.⁶⁴ This means that 28% of eligible German general government debt would gradually be transformed into E-bonds. When it comes to maturity, for every € 100 of German debt that are refinanced in the markets, 28% would be refinanced through E-bonds issued by the common issuer and 72% through junior national bonds issued by the German government. This way the subordination rate would be kept constant until the target volume of E-bonds is reached.⁶⁵ At the same time, this may imply a relatively long transition period, in absence of actions to speed up this process, such as through offering swaps to holders of grandfathered bonds.

Reflecting the grandfathering, repayment in the unlikely case of default during the transition period would follow the sequencing explained in the following example. Assuming € 100 of total debt and that € 60 are still in the form of legacy *pari-passu* bonds, in the example of Germany the remaining € 40 would be split between € 28.8 of national junior bonds and € 11.2 of loans from the E-bond issuer.⁶⁶ In the event of a default with a general haircut of 30%, the holders of the legacy *pari-passu* bonds would receive 70% of the face value (€ 42). The combined amount of E-bonds and junior bonds (€ 40) would likewise suffer a haircut of 30% (€ 12). The remaining € 28 would be used to pay first the senior loans (€ 11.2). This would leave the holders of national junior bonds with € 16.8, implying an effective haircut of 41.6%. E-bond holders would thus

⁶³For simplicity, it is assumed that the debt-to-GDP ratio of the country does not change during the transition. Otherwise the subordination rate would be adjusted accordingly.

⁶⁴Based on debt levels as at year-end 2017 and excluding non-central government loans from an E-bonds scheme.

⁶⁵It is also important to note that, relative to other proposals such as Accountability bonds or Purple bonds, in the E-bonds model, junior national bonds would never be subordinated to the whole stock of debt.

⁶⁶Reflecting the subordination rate of 72%.

Figure 11: Illustration of a default scenario during transition towards E-bonds

	BEFORE	AFTER (in transition)
Face value	<div>€ 100 pari-passu national bonds</div>	<div>€ 60 pari-passu national bonds</div> <div> <div>€ 11.2 senior common issuer loans</div> <div>€ 28.8 junior national bonds</div> </div>
Recovery value (30% haircut)	<div>€ 70 pari-passu national bonds</div>	<div>€ 42 pari-passu national bonds</div> <div> <div>€ 11.2 senior common issuer loans</div> <div>€ 16.8 junior national bonds</div> </div>

Note: example of the impact of a default in the transition phase, where only 40% of the original stock has been rolled over, with the junior bond (with a subordination rate of 72%) underpinning the seniority of loans received from the common issuer. As the haircut is smaller than the subordination rate, the common issuer is repaid in full, with junior bond holders suffering a larger loss, while holders of “old” grandfathered bonds suffer a standard *pari-passu* haircut.

be fully protected by subordination and suffer no losses. This split is presented in Figure 11.

Once a yield curve for E-bonds is created, the transition could be accelerated to reach the target E-bond volume more quickly. For this purpose, the loans from the common issuer to the Member States could be larger than their roll-over needs. This additional funding could be used by DMOs to replace grandfathered (*pari-passu*) bonds through a liability management exercise, for example by offering a debt swap.⁶⁷

An initial focus on short-term issuances could increase the market acceptance of E-bonds and offer a number of potential benefits in terms of costs for DMOs, financial stability and several other aspects (Section 7). A successful introduction of the common safe asset could lead to lower credit and liquidity

⁶⁷The swap would respect the same subordination rate calculated initially for each Member State. In the example of Germany. For each € 100 of *pari-passu* central government debt securities that are part of the swap, 28% would be refinanced through E-bonds and 72% through junior national bonds.

premia as a result of the general equilibrium effects considered in Section 9, which in turn could create room for a further increase in the average maturity and the volume of E-bonds without adversely affecting Member States' funding costs.

Dealing with possible losses faced by the common issuer of E-Bonds

To address the tail risk of losses on the senior loans, including for the unlikely event that a haircut could be larger than assumed in our simulations or exceed the subordination buffers considered in this paper, the common issuer could be endowed with a capital buffer. The size of this buffer could be very small for a volume of E-bonds below 20% of euro area GDP, in view of the limited tail risks presented earlier (Section 5).⁶⁸ This limited risk sharing in the form of a common credit enhancement would benefit all Member States by lowering the risk premia on E-bonds and appears compatible with Article 125 TFEU, as suggested by the Pringle case on the capital buffer of the ESM.⁶⁹ It would mean that if ever a haircut is experienced on a senior loan, E-bond holders should never incur any loss. At the same time, if tail risks would ever materialise, the existence of a capital buffer would be preferable to a situation without such a buffer where governments could end up in difficult discussions on whether and how to cover the losses on the senior loans, not having defined this ex-ante.

One could consider several ways to build a capital cushion, which may be complementary. One possibility would be for participating Member States to transfer to the common issuer an amount equivalent to the profits accrued to the Eurosystem from the Securities Market Programme (SMP) since its launch, which are expected to amount to € 72.6 billion.⁷⁰ This would be consistent with the fact that the SMP programme was enacted to ensure depth and liquidity in malfunctioning segments of the debt securities markets, and that profits from that operation could be further used for sheltering the euro area from those risks, which is also one of the objectives of introducing a European safe asset. Another possibility, which would not entail any transfer from participating Member States but rather build on the advantages from the common safe asset, would be to accrue part of the initial benefits from the project to a capital buffer

⁶⁸The capital buffer could be significantly smaller than suggested in Zettelmeyer and Leandro (2018), given more favourable VaR results in this paper.

⁶⁹In its Pringle Judgment, the European Court of Justice did not go along with the very broad interpretations of Article 125 TFEU advocated by some parties. Instead, the only constructions that can be ruled out with certainty are those where: (i) Member States' liabilities are assumed by its peers, i.e. the Member State is (partially) freed of its relevant liabilities due to a bail-out operation, and (ii) there is no mechanism to ensure (sufficiently strong) incentives for sound budgetary policies (see European Court of Justice (2012)). Conversely, constructions that meet these two criteria could be judged compatible with the Treaty, which potentially leaves room for a relatively large range of design options. At the same time, a construction with higher degree of mutualisation is more likely to be incompatible with EU Law, unless a suitable incentive mechanism is found to accompany it.

⁷⁰See ECB (2019).

by applying a markup on the pricing of the loans from the common issuer for a given initial period. There are possibly other sources that could be envisaged.⁷¹

An additional tail risk is that a Member State would decide not to honour the seniority of the loans and pay other claims first, despite the legal obligation and the existence of a sufficient subordination buffer.⁷² This extreme case is relevant not only for E-Bonds, but also for any other policies with financial implications among Member States and relevant to the functioning of the EU.⁷³ As long as the Member State remains in the euro area and in the EU, there would be substantive ways to exert pressure on it to comply with the full repayment of the senior loans.⁷⁴ If a Member State decides to voluntarily leave the EU, the ongoing Brexit process shows that financial obligations would be an important part of the exit negotiations.

Distribution, incentives and buffers

Both the transition and the steady state, depending on how they are managed, could deliver some financial benefits for Member States, and also some cross-subsidisation. The analysis by “Z-L” and the results presented in Table 5 show that the volume of cross-subsidisation would be very small, yet the related dynamics and incentives merit consideration.⁷⁵

A possible way to address distribution effects and create appropriate incentives possibly linked to the European economic governance framework would be through an articulated pricing schedule for the senior loans in the steady state. This could possibly include up to three components, (i) an administrative fee to cover the operational costs of the common issuer, (ii) a capital-contribution fee that would allow the gradual build-up of a buffer to cover tail risks, and (iii) a withholding component that can only be distributed to Member States after evidence that they comply with the regular multilateral surveillance and coor-

⁷¹One further possibility concerns gold reserves. The very creation of the euro and the pooling of monetary sovereignty into the ECB have made the cumulated pre-existing stock of gold reserves across EA countries in part redundant, as indicated when compared to what is needed in other monetary unions such as the US to underpin the credibility of the monetary policy. Accordingly, a tiny fraction of the excess in national gold reserves could also be devoted by Member States (and/or national central banks) to support this project. Differently from the transfer of SMP profits, it would probably not have a budgetary impact for Member States.

⁷²It is important to clarify here that the seniority of loans would not apply with respect to current obligations of the government such as to pay wages or pensions. To avoid any doubt on this matter, this would need to be carefully spelled out in the legal texts underpinning the construction.

⁷³For instance, the legal obligations related to the functioning of the EMU and of the Eurosystem.

⁷⁴For example, any disbursement from the EU budget to that Member State could be suspended because of the severe breach in the rule of law. It could also be envisaged that the suspended EU budget allocation may be diverted to the repayment of the senior claims until the latter is fully honoured, though this may require some legal changes.

⁷⁵Table 5 shows that the average financing costs increase or decrease for some countries, which can be seen as a measure of cross-subsidisation (in an partial equilibrium context).

dination processes.⁷⁶ The latter component, together with the stronger market pressure,⁷⁷ would provide a significant boost to the incentives for the conduct of sound national fiscal policies. This could not only increase compliance with the fiscal framework, but also possibly facilitate its simplification given that market pressure needs to play a role, together with fiscal rules and institutions, in an efficient and effective fiscal framework.

As a way to manage potential turbulence in national bond markets, it could be envisaged that the cap set for the total E-bonds issuance foresees a buffer to be used in exceptional times. For example, it could be decided that a cap for E-bonds issuance is set at 20% of GDP, but actual issuance only reaches 15% of GDP. This would provide a buffer of 5% of GDP that could be activated if necessary in periods of stress when Member States may face temporary difficulties in accessing markets. This would both reduce the amounts that Member States would need to place directly on the market via national bonds, and boost the supply of common safe assets at a moment when they are more demanded, complementing any monetary policy action.

9 General equilibrium and dynamic effects

The previous sections presented results based on static simulations of shifts in credit risk between two components of government debt, a part funded directly on bond markets and a part funded via loans from a common issuer. As such, credit risks are simply shifted from one component to the other, but the overall amount of risk is assumed to remain unchanged. However, several general equilibrium effects are expected with the issuance of E-bonds, as soon as they would reach a sufficient size. Further research could shed light on a number of them, such as:

- By increasing marginal funding costs, E-bonds would improve the incentives for prudent fiscal policies, thereby reducing the overall risks to the sustainability of public finances in euro area countries over time. There is evidence of euro area governments reacting to the marginal costs of funding.⁷⁸ Increasing the latter through subordination should therefore improve fiscal outcomes. In addition, as explained later in this section,

⁷⁶For example, in case of no-compliance with the EU rules for economic and fiscal coordination, the E-bond issuer would retain the withholding component of that country and assign it to the capital buffer. Compliance should be established on the basis of the Union's framework for economic and fiscal coordination, without any duplication of surveillance processes, and the transfer of the benefits could be done on an-ex post basis. The distribution of the profits from the Agreement on Net Financial Assets to Greece in the post-programme environment (as part of the debt-reducing measures adopted in 2018 by the Eurogroup) gives a useful indication of the powerful incentives that such a solution could create. The grant of roughly 0.5% of GDP was transferred in Spring 2019 only after an ex-post assessment of Greece's compliance with its commitments, including the fiscal targets.

⁷⁷Market pricing could become more consistent to the extent that the introduction of E-bonds could reduce redenomination risks, and also deliver a stronger price signal on national bonds (through higher marginal costs of funding).

⁷⁸See Meyermans (2019).

the pricing of the E-bonds could be established in a such a way as to increase incentives to comply with the European economic coordination and surveillance framework.

- The higher liquidity of the common safe asset (compared to national bonds) could help harness a global liquidity premium advantage, currently enjoyed mainly by US treasuries.⁷⁹ At the same time, the liquidity of shrinking national bond markets would need to be assessed and managed to mitigate negative effects and identify possible synergies.⁸⁰ There is therefore a case for investigating the liquidity risk premia that E-bonds could command and the counterfactual liquidity premia on remaining national bonds.
- The holding by the banking sector of a significant amount of supranational bonds would not only “statically” reduce exposures, as outlined in Section 7, but could also avoid feedback loops and dangerous interactions with uncertainties in national policies — which in the past have led to asymmetric effects⁸¹ in the market pricing of bonds with respect to fundamentals, possibly reflecting inter alia the appearance of redenomination risks. This could help to stabilise risk premia in times of stress and possibly reduce the overall riskiness of European sovereigns. In turn, this dynamic effect could offset the impact on marginal funding costs for vulnerable countries of issuing higher volumes of E-bonds.
- Stronger financial stability, more predictable fiscal policies and more effective transmission of monetary policy could support higher investment and potential growth. This could in turn have favourable effects on the debt dynamics, via both the denominator and the numerator. As such, debt levels could reduce faster for any given fiscal effort, improve the sustainability of public finances, and further reduce credit risk, mitigating the impact on marginal funding costs from subordination.

⁷⁹ECB (2019) finds that: “Some euro area sovereigns enjoy an economically significant ‘exorbitant privilege’ stemming from large holdings of foreign central banks relative to outstanding euro area safe debt. As foreign central bank holdings of euro area government debt are concentrated in a few euro area countries issuing debt that is seen as risk-free, the ‘exorbitant privilege’ can be interpreted as having contributed to widening intra-euro area sovereign bond spreads. One ingredient for a stronger international role of the euro is to have a larger supply of safe assets. This can, for instance, be achieved by maintaining or restoring sound and sustainable fiscal policies throughout the euro area. In the longer term, the creation of a common euro area safe asset, if so decided by Member States, in a way that does not undermine incentives for sound national fiscal policies, could also contribute to this objective. An indirect benefit of a strong international role of the euro would be that the euro’s ‘exorbitant privilege’ would be more widely shared across euro area sovereigns.”

⁸⁰While the total size of national bond markets would shrink, this does not necessarily mean that liquidity would deteriorate to the same extent or at all. For instance, the existence of a European yield curve could eliminate the need for at least some national DMOs to maintain a national yield curve, allowing them to concentrate issuances on a few maturities. This could reduce operational costs and result in larger ticket sizes and overall more liquid market segments than is currently the case.

⁸¹See Monteiro and Vašíček (2019).

10 Conclusions

Several arguments call for issuing a large and homogeneous European safe asset: it would reduce banks' exposure to national sovereign bonds, support a smooth and symmetric transmission of monetary policy, facilitate the completion of the Banking Union, creating a benchmark for the Capital Markets Union, strengthen the international role of the euro and — in a construction such as E-bonds — increase the incentives for sound national economic and budgetary policies.

This paper makes several contributions. It reviews the modelling techniques and underlying assumptions used in previous studies, based on the available empirical evidence and a full sample of available time series for credit default expectations. This leads to a choice of more conservative probabilities of default and losses given default that are solidly grounded on the historical experience of the euro area, on the available data on sovereign credit events and on industry practice. Using this revised (fuller-evidence) assumptions, the paper recalculates the credit risk implicit in national bonds, SBBS and E-bonds. The results suggest that a higher degree of conservatism may be warranted as regards the expected losses for the most creditworthy Member States, with the reverse being true for the less creditworthy countries, compared to previous studies.

The paper also deepens the analysis on the capacity of the E-bonds model to deliver a common safe asset for the euro area. Previous analyses, looking at different approaches, suggest that E-Bonds have attractive features in terms of safety, liquidity and incentives, while being compatible with the EU legal framework. This paper proposes a streamlined construction for E-Bonds, which would place Member States and their national debt management offices at the centre of the governance and help to increase the political acceptance of the construction. The credit risk simulations show that this streamlined E-bond construction — without securitisation nor mutualisation — could achieve the needed scale and creditworthiness to become the main safe asset in the euro area.

The paper also assesses quantitatively the impact of introducing E-bonds on the remaining national bonds, which would continue to exist. The results confirm that the introduction of E-bonds would — *ceteris paribus* — exert pressure on national bond yields. Higher marginal funding costs would boost incentives for more prudent fiscal policies. At the same time, average funding costs should remain broadly unchanged, hence not impacting negatively on Member States' debt sustainability prospects. This provides the basis for a possible calibration of the size of the E-bonds scheme that balances various trade-offs. The potential size of the E-bond issuance would be constrained not so much by the credit risk of E-bonds themselves but by the wish to preserve the rating of current triple-A issuers or to contain the increase in the marginal cost of funding for less creditworthy sovereigns.

The paper also illustrates the potential impact of E-bonds on financial markets, in line with their goals. A comparison with the outstanding volumes of debt securities issued by euro area countries shows that E-bonds could achieve sufficient scale and safety — comparable to those of Member States with the

highest credit rating – and become the main safe asset in the euro area. A comparison with the maturity pattern of US sovereign debt shows, for example, the potential for making E-bonds the main debt instrument in the euro area for maturities of less than two years. Based on the current sovereign exposures of banks, insurers and pension funds, illustrative scenarios show that E-bonds could deliver a significant reduction in exposure to national sovereign risk as well as in the degree of home bias.

Even at a lower bound of 15% of euro area GDP, and with an issuance pattern focused on short-term maturities, E-bonds would already deliver important benefits for all participating Member States: (i) they would likely enjoy a top credit quality, on some accounts possibly performing even better than the German bund, whose triple-A credit rating would be preserved, (ii) incentives for sounder policies would be created, as the marginal funding cost for high-debt countries would increase moderately while average funding costs would stay broadly constant, (iii) the volume and term structure would be sufficient to generate a very liquid short term market, which is currently underdeveloped in the euro area when compared to the US and (iv) they could become the reference safe asset for the banking sector and monetary policy operations in the euro area.

The paper looks also at some operational questions, including (i) the transition towards the steady state, based on the grandfathering of existing debt and an initial focus on short-term maturities to minimise risks, (ii) the need to foresee extreme cases to reduce any uncertainty on possible implications for participating Member States, and (iii) how to create further incentives for Member States by possibly linking the issuance of E-Bonds with the European framework for economic and budgetary coordination and surveillance.

Finally, the paper considers briefly some possible dynamic and general equilibrium effects that could materialise from the stabilising properties of a common safe asset of sufficient safety and size such as E-bonds: an improved transmission of monetary policy, stronger incentives for responsible fiscal (and other economic) policies, lower scope for asymmetric behaviour of markets (including from a closer alignment of bond prices with fundamentals and from a reduction in redenomination risks), as well as the potential liquidity premia advantage from a common safe asset of global relevance. Stronger financial stability and better government policies could reduce risks in the euro area and support higher investment and potential growth, which would improve the sustainability of government finances, and reduce macroeconomic imbalances in self-reinforcing dynamics.

There are several areas where further research seems warranted. This includes (i) exploring the behaviour of investors – both from within and outside the euro area – in the face of the new characteristics (as regards, e.g., ticket sizes, maturities and yields) of sovereign bonds supplied in Europe, (ii) identifying and studying the general equilibrium effects referred to above, (iii) considering the legal and operational aspects linked to any concrete introduction of a safe asset in the form of E-bonds, and (iv) looking more closely at the political economy aspects which appear critical for the success of such an endeavour.

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A Replicating the CDS-based calibration of Brunnermeier et al (2017)

The risk parameters used by “B-et-al”, specifically the PDs and LGDs for each state of the economy shown in Table 7, are set in a relatively loose manner, being subject only to monotonicity rules and consistency check between average expected losses (or, possibly, expected PDs) and sovereign CDS data observed in a particular month (December 2015).

This paper uses instead empirically-grounded assumptions for conducting an assessment of sovereign credit risk. In order to employ the “B-et-al” methodology, a first exercise is to replicate the inference of the original parameters as shown in Table 7.

Table 7: Credit risk parameters in Brunnermeier et al. (2017)

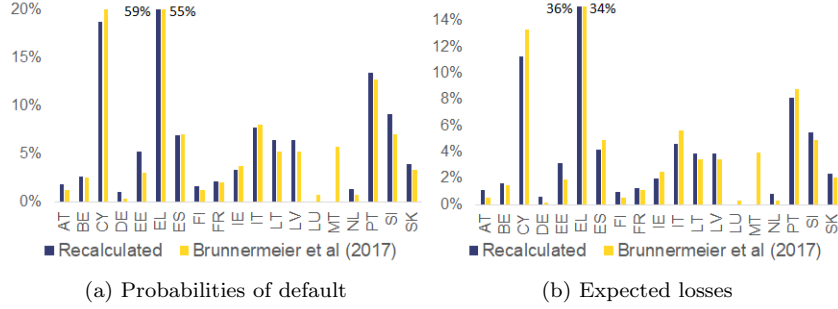
Cycle phase	Severe recession	Mild recession	Expansion	Severe recession	Mild recession	Expansion			
<i>Prob</i>	5%	25%	70%	5%	25%	70%			
Member State	PD1	PD2	PD3	LGD1	LGD2	LGD3	Expected PD	Expected LGD	Expected loss
Germany	5	0,5	0	40	32	20	0,4	24,0	0,14
Netherlands	10	1	0	40	32	20	0,8	24,0	0,28
Luxembourg	10	1	0	40	32	20	0,8	24,0	0,28
Austria	15	2	0	45	36	22,5	1,3	27,0	0,52
Finland	15	2	0	45	36	22,5	1,3	27,0	0,52
France	25	3	0,05	60	48	30	2,0	36,0	1,12
Belgium	30	4	0,1	62,5	50	31,25	2,6	37,5	1,46
Estonia	35	5	0,1	67,5	54	33,75	3,1	40,5	1,88
Slovakia	35	6	0,1	70	56	35	3,3	42,0	2,09
Ireland	40	6	0,3	75	60	37,5	3,7	45,0	2,48
Latvia	50	10	0,3	75	60	37,5	5,2	45,0	3,45
Lithuania	50	10	0,3	75	60	37,5	5,2	45,0	3,45
Malta	55	11	0,4	78	62,4	39	5,8	46,8	3,97
Slovenia	60	15	0,4	80	64	40	7,0	48,0	4,91
Spain	60	15	0,4	80	64	40	7,0	48,0	4,91
Italy	65	18	0,5	80	64	40	8,1	48,0	5,62
Portugal	70	30	2,5	85	68	42,5	12,8	51,0	8,82
Cyprus	75	40	10	87,5	70	43,75	20,8	52,5	13,34
Greece	95	75	45	95	76	47,5	55,0	57,0	33,73

Source: Brunnermeier et al. (2017), own calculations.

When setting the credit risk parameters for their simulations, Brunnermeier et al. (2017) seek to ensure a degree of consistency between their assumed expected losses (or, possibly, their assumed expected PDs) and sovereign CDSs observed for December 2015. Replicating their CDS-based calibration is made difficult by the unavailability of the original sources and some imprecise statements:

1. It is unclear which was the original data source, CDS definition and finan-

Figure 12: 5-year sovereign probabilities of default and expected losses (December 2015)



Source: Brunnermeier et al. (2017), Bloomberg, own calculations.

cial formula (e.g., full or simplified) used to infer sovereign PDs. This is because the authors rely on PDs inferred and published online by Deutsche Bank (DB), based on CDS data for December 2015. As of 2019, DB no longer publishes these PDs, and full information on the derivation details required for replication is not available;

2. “B-et-al” state that DB assumes a “constant LGD rate of 40%” when deriving the PDs, whereas a presentation by DB⁸² and an archived version of the webpage⁸³ show that DB rather assumes a conventional recovery rate of 40% by default, and therefore a conventional LGD of 60%;
3. “B-et-al” select the parameters such that average default rates are “consistent with market prices.” However, the authors’ default rates (i.e., PDs) can only be compared to the default rates inferred by DB from market prices (i.e., CDS) under the same assumptions for LGDs. This, however, is not the case, in particular as the “B-et-al” LGDs are country-specific (see Table 7), whereas DB’s LGDs are constant and set at conventional levels.

Whether, and the extent to which, points 2. and 3. have an impact on the calculation of the risk parameters is not immediately clear. Figure 12 compares the 5-year PDs and expected losses of “B-et-al” with recalculated PDs and expected losses inferred via standard, simplified financial formulae⁸⁴ from average

⁸²See the online presentation by Deutsche Bank Research available from http://nzz-files-prod.s3-website-eu-west-1.amazonaws.com/files/4/1/2/cds+deutsche+bank+161214_1.18446412.pdf.

⁸³[https://web.archive.org/web/20160316082947/http://www.dbresearch.com/servlet/reweb2.ReWEB?rwnode=DBR_INTERNET_EN-PROD\\$EM&rwoobj=CDS.calias&rwsite=DBR_INTERNET_EN-PROD](https://web.archive.org/web/20160316082947/http://www.dbresearch.com/servlet/reweb2.ReWEB?rwnode=DBR_INTERNET_EN-PROD$EM&rwoobj=CDS.calias&rwsite=DBR_INTERNET_EN-PROD).

⁸⁴I.e., $EL_{i,t} = PD_{i,t} \times LGD_{i,t}$, with $PD_{i,t} = 1 - e^{(-T \times CDS_{i,t} / LGD_{i,t})}$, where T represents the number of years of the CDS contract – 5, in our case – and LGD is set at a conventional 60%.

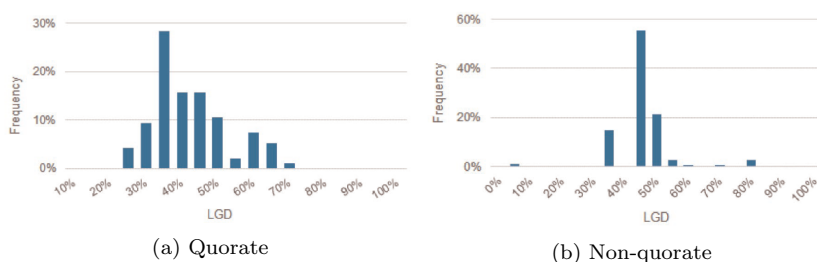
CDS data for December 2015. The CDS data is taken from Bloomberg and is based on the ISDA 2014 definitions.

Overall, the original PDs and ELs of “B-et-al” are relatively close to the values we obtain. This is therefore a good indication that the results which we present throughout the paper are essentially driven by the use of new underlying assumptions, rather than by differences in methodology. It should be noted in this regard that for Germany and for the Netherlands, “B-et-al” do not rely on CDS-based calibration, which explains why the recalculated PDs and ELs are noticeably higher (though still very low relative to other countries). Also, no recalculated figures are reported for Luxembourg and Malta due to the absence of CDS data for these countries.

B Banks' estimates of sovereign LGDs

Banks' estimations of sovereign LGDs can vary significantly, but their average value tends to be well below 65%, while estimates higher than this figure are very unusual. This can be observed in Figure 13, which shows the results of a 2016 survey of banks following the “Advanced” IRB approach. In addition, a survey of EU banks by the European Banking Authority focusing on low default portfolios puts the maximum estimated sovereign LGD just below 60% in 2017. However, the interquartile range was much lower, in the whereabouts of 27% to 45% (see Figure 14).

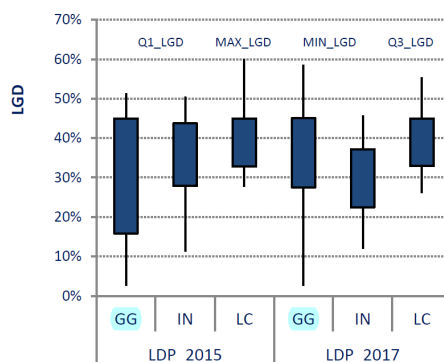
Figure 13: Distribution of banks' sovereign LGD estimations



Note: quorate refers to a smaller sample of multi-banked obligors and non-quorate to a larger sample of single bank obligors.

Source: Credit Benchmark.

Figure 14: Distribution of banks' sovereign LGD estimations in low default portfolios in 2015 and 2017



Note: GG denotes general governments, IN denotes institutions and LC denotes large companies.

Source: European Banking Authority.

Table 8 presents information on sovereign LGD estimates, as disclosed by a set of large banks domiciled in five different euro area jurisdictions. It can be observed that average overall LGDs are, in all cases, well below 65%. By inspecting LGDs per PD risk bucket, it can also be observed that (i) rarely do average estimated LGDs exceed 65% and (ii) there is no clear correlation between estimated PDs and LGDs.

Table 8: Average estimated sovereign LGDs per PD bucket for 5 large euro area banks

PD range	BNP Paribas	Deutsche Bank	Santander	ING	Unicredit
0.00 to <0.15%	2%	50%	45%	30%	21%
0.15 to <0.25%	10%	47%	50%	35%	31%
0.25 to <0.50%	29%	50%	50%	42%	37%
0.50 to <0.75%	13%	50%	30%	NA	43%
0.75 to <2.50%	24%	58%	50%	39%	46%
2.50 to <10.00%	8%	49%	82%	12%	51%
10.00 to <100.00%	8%	50%	70%	3%	54%
100% (Default)	NA	49%	50%	31%	73%
Overall	2%	53%	46%	30%	21%

Note: some PD buckets contain only small, possibly undiversified, exposures, which may explain large changes across buckets.

Source: Banks' risk disclosure reports under Pillar 3 (2017).

C Comparison of PDs and ELs in different states of the economy

Table 9 compares PDs and ELs under the “B-et-al” assumptions and under the recalculated full-sample figures, across the three states of the economy. It is worth noting that, in three cases, Member States’ PDs do not increase with a severe euro area recession when compared with a mild euro area recession. Therefore, monotonicity of country specific PDs over the states of the euro area economy does not appear to be a universal empirical fact. This reflects the imperfect synchronization of the national economic, fiscal and political cycles with respect to the overall European cycles.

Table 9: Comparison of PDs and ELs in different states of the economy

Member State	<i>Severe recession</i>				<i>Mild recession</i>				<i>Expansion</i>				<i>Average</i>	
	PD		EL		PD		EL		PD		EL		EL	
	“B-et-al”	Fuller evidence	“B-et-al”	Fuller evidence	“B-et-al”	Fuller evidence	“B-et-al”	Fuller evidence	“B-et-al”	Fuller evidence	“B-et-al”	Fuller evidence	“B-et-al”	Fuller evidence
AT	15%	15%	6,8%	6,9%	2%	10%	0,7%	3,5%	0%	4%	0,0%	1,2%	0,5%	1,7%
BE	30%	17%	18,8%	10,4%	4%	7%	2,0%	3,5%	0%	4%	0,0%	1,6%	1,5%	2,1%
CY	75%	61%	65,6%	39,6%	40%	59%	28,0%	30,5%	10%	34%	4,4%	14,6%	13,3%	17,5%
DE	5%	10%	2,0%	3,8%	1%	5%	0,2%	1,7%	0%	3%	0,0%	0,8%	0,1%	1,1%
EE	35%	9%	23,6%	5,9%	5%	22%	2,7%	11,6%	0%	8%	0,0%	3,4%	1,9%	4,7%
EL	95%	100%	90,3%	64,9%	75%	33%	57,0%	17,4%	45%	31%	21,4%	13,3%	33,7%	15,4%
ES	60%	29%	48,0%	18,9%	15%	12%	9,6%	6,3%	0%	7%	0,2%	3,2%	4,9%	4,1%
FI	15%	7%	6,8%	3,1%	2%	5%	0,7%	1,7%	0%	3%	0,0%	0,8%	0,5%	1,0%
FR	25%	14%	15,0%	8,1%	3%	5%	1,4%	2,6%	0%	4%	0,0%	1,4%	1,1%	1,8%
IE	40%	35%	30,0%	22,6%	6%	15%	3,6%	7,8%	0%	9%	0,1%	3,9%	2,5%	5,0%
IT	65%	29%	52,0%	18,8%	18%	13%	11,5%	6,9%	1%	9%	0,2%	4,0%	5,6%	4,8%
LT	50%	18%	37,5%	11,8%	10%	12%	6,0%	6,5%	0%	13%	0,1%	5,8%	3,5%	6,1%
LV	50%	19%	37,5%	12,1%	10%	32%	6,0%	16,7%	0%	14%	0,1%	5,9%	3,5%	7,6%
LU	10%	12%	4,0%	4,7%	1%	7%	0,3%	2,4%	0%	4%	0,0%	1,1%	0,3%	1,4%
MT	55%	14%	42,9%	8,9%	11%	23%	6,9%	11,9%	0%	10%	0,2%	4,3%	4,0%	5,5%
NL	10%	12%	4,0%	4,7%	1%	7%	0,3%	2,4%	0%	4%	0,0%	1,1%	0,3%	1,4%
PT	70%	51%	59,5%	33,1%	30%	16%	20,4%	8,3%	3%	14%	1,1%	6,2%	8,8%	7,3%
SI	60%	26%	48,0%	16,7%	15%	14%	9,6%	7,4%	0%	10%	0,2%	4,2%	4,9%	5,0%
SK	35%	16%	24,5%	10,6%	6%	9%	3,4%	4,9%	0%	5%	0,0%	2,2%	2,1%	2,8%

Source: Brunnermeier et al. (2017), own calculations.

D Expected losses on national bonds per E-bond issuance size under the “B-et-al” assumptions

Table 10: Expected losses on national bonds per E-bond issuance size under the “B-et-al” assumptions

	B-et-al assumptions												
	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	0,1	0,1	0,2	0,2	0,2	0,3	0,3	0,4	0,4	0,4	0,4		
NL	0,3	0,3	0,3	0,4	0,5	0,5	0,7	0,7	0,7	0,7			
LU	0,3	0,4	0,7										
AT	0,5	0,5	0,6	0,6	0,7	0,8	0,9	1,0	1,1	1,2	1,2	1,2	1,2
FI	0,5	0,6	0,7	0,8	1,0	1,2	1,2	1,2	1,2				
FR	1,1	1,2	1,3	1,4	1,5	1,7	1,8	1,9	2,0	2,0	2,0	2,0	2,0
BE	1,4	1,5	1,6	1,7	1,8	2,0	2,1	2,3	2,4	2,5	2,5	2,5	2,5
EE	1,8	3,0											
SK	2,1	2,3	2,7	3,1	3,3	3,3	3,3	3,3	3,3				
IE	2,4	2,6	2,9	3,2	3,4	3,5	3,5	3,5	3,5	3,5	3,5		
LV	3,4	4,2	4,9	5,2	5,2	5,2							
LT	3,4	4,0	4,7	5,1	5,2	5,2	5,2						
MT	3,9	4,3	4,7	5,1	5,4	5,7	5,7	5,7	5,8	5,8	5,8	5,8	5,8
SI	4,9	5,4	6,1	6,7	7,0	7,0	7,1	7,1	7,1	7,1			
ES	4,9	5,4	5,9	6,4	6,9	7,0	7,0	7,1	7,1	7,1	7,1	7,1	
IT	5,6	5,9	6,3	6,6	7,0	7,3	7,6	8,0	8,1	8,1	8,1	8,1	8,2
PT	9,0	9,5	10,2	10,8	11,4	12,1	12,5	12,6	12,7	12,9	13,0	13,0	13,0
CY	13,6	14,3	15,1	15,9	16,7	17,5	18,6	19,0	19,3	19,8	20,4	21,1	21,1
EL	34,2	35,6	36,6	38,1	39,7	41,4	42,9	44,4	45,5	46,8	47,8	49,4	51,2
E-bond		0,0	0,0	0,1	0,2	0,5	0,7	0,9	1,2	1,4	1,6	1,8	2,0

Note: a blank figure denotes a situation where the E-bond scheme size exceeds the amount of eligible sovereign debt outstanding as of year-end 2017, so that no national bonds are issued.

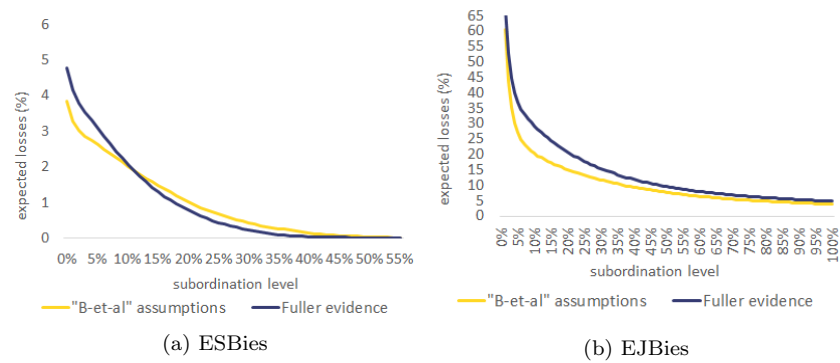
Source: Own calculations.

E Simulation results under the adverse calibration

This appendix reproduces the simulation results under the adverse calibration of Brunnermeier et al. (2017). In the adverse calibration, default correlations across countries are driven not only by the common state of the euro area economy but also by assuming increases in the PDs of other Member States in the event of a default of Germany, France, Italy or Spain. Besides increasing cross-country correlations, the implementation of the adverse scenario is such as to increase the PDs and ELs of all euro area countries. This means that the actual risk parameters underlying the simulations deviate from those shown in Table 9, both for the “B-et-al” and the fuller-evidence assumptions used in this paper. While the adverse calibration violates the law of total probability and unhinges risk parameters from their empirical basis, it can be employed as a stress test of the results presented in this paper.

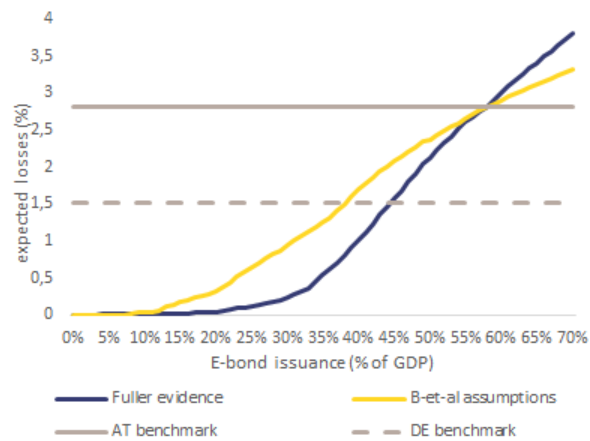
The adverse calibration confirms that E-bonds remain safe at high issuance levels, with safety ranges similar to those found under the benchmark calibration. In understanding this result, it should be noted that the adverse calibration leads both to an upward shift in the ELs of E-bonds and in the EL of the safety benchmarks. As expected, tail risks increase under the adverse calibration given the stronger default correlation. However, the maximum possible losses remain the same, as they are determined by the LGDs and the amounts of subordinated debt. As with the benchmark calibration, tail risks remain contained for issuance sizes up to 30% of GDP, and the VaR of E-bonds compares well with that of the safest countries in the sample. The amount of safe assets that can be created with an E-bonds scheme is likewise similar to the values based on the benchmark calibration. The conclusion that average funding costs stay broadly constant for most Member States, while decreasing markedly for low debt countries, also holds when E-bonds represent 15% to 30% of GDP. Finally, the safety level of ESBies is not always lower in the adverse calibration under the fuller-evidence assumptions. However, as explained above, the adverse calibration partly overrides these assumptions, which means that this result for SBBS should be read with caution.

Figure 15: 5-year expected losses on ESBies and EJBies, per subordination level



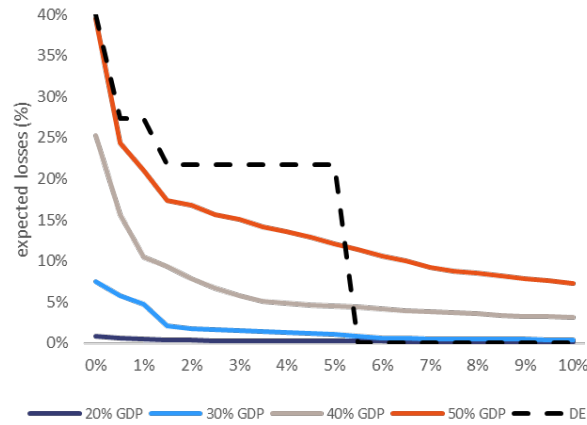
Source: Own calculations.

Figure 16: 5-year expected losses on E-bonds



Source: Own calculations.

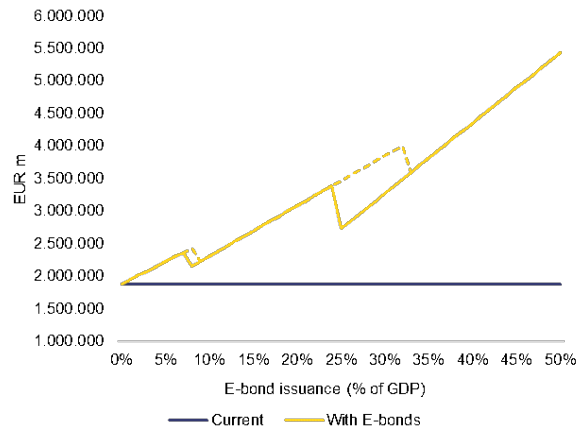
Figure 17: Value-at-risk of E-bonds per issuance size



Note: solid lines represent the VaR of E-Bonds, for different scheme sizes. The dashed line represents the model-based VaR for Germany, for comparison purposes. The VaR for the 0% quantile represents the maximum possible losses. Based on the fuller-evidence assumptions.

Source: Own calculations.

Figure 18: Safe asset volumes per E-bond issuance size



Note: current amounts based on AAA sovereign bonds as of year end 2017 (that is, issued by Germany, the Netherlands and Luxembourg); amounts under E-bonds are based on Austria's EL threshold; the dashed line shows the maximum achievable amount if all remaining national debt can be subordinated to the loans from the central issuer.

Source: Own calculations.

Table 11: Expected losses on national bonds (in %) per E-bond issuance size (as a % of GDP)

	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	1,5	1,7	1,9	2,1	2,4	2,9	3,4	4,4	5,3	5,3	5,3		
NL	2,4	2,6	3,0	3,4	4,0	4,8	6,1	7,8	8,2	8,2			
LU	2,4	3,7	7,8										
AT	2,8	3,0	3,3	3,6	3,9	4,3	4,9	5,5	6,4	7,5	8,6	8,6	8,6
FI	2,1	2,4	2,8	3,3	4,1	5,2	6,5	6,5	6,5				
FR	3,5	3,8	4,1	4,4	4,8	5,5	6,1	6,8	7,7	8,1	8,1	8,1	8,1
BE	4,8	5,1	5,4	5,7	6,1	6,6	7,1	7,8	8,4	9,3	10,0	10,6	10,6
EE	7,3	15,6											
SK	8,5	9,6	11,1	13,2	15,9	18,2	18,2	18,2	18,2				
IE	10,3	11,3	12,5	14,1	16,1	18,4	21,1	22,1	22,1	22,1	22,1		
LV	12,6	15,4	19,4	25,7	27,2	27,2							
LT	11,3	13,3	15,9	20,0	24,6	24,6	24,6						
MT	10,8	11,7	12,9	14,2	15,9	17,9	20,5	23,0	23,3	23,3	23,3	23,3	23,3
SI	10,3	11,4	12,9	14,9	17,3	20,3	22,2	22,2	22,2	22,2			
ES	7,6	8,4	9,2	10,3	11,7	13,2	15,2	16,3	16,3	16,3	16,3	16,3	
IT	8,0	8,5	8,9	9,4	10,0	10,7	11,5	12,4	13,3	14,4	15,3	16,5	17,2
PT	12,2	13,0	13,9	14,9	16,1	17,4	19,1	20,8	23,3	25,6	26,3	26,3	26,3
CY	21,1	22,2	23,5	24,9	26,4	28,2	30,6	33,0	35,6	38,7	41,8	45,3	45,8
EL	19,1	19,9	20,5	21,5	22,5	23,6	24,5	25,8	27,3	28,9	30,2	32,1	34,2
E-bond		0,0	0,0	0,0	0,0	0,1	0,2	0,5	1,0	1,6	2,1	2,6	3,0

Note: based on the fuller-evidence assumptions; the last row shows the EL on E-bonds; a blank figure denotes a situation where the E-bond scheme size exceeds the amount of eligible sovereign debt outstanding as of year-end 2017, so that no national bonds are issued.

Source: Own calculations.

Table 12: Expected losses on national bonds per E-bond issuance size under the “B-et-al” assumptions

	B-et-al assumptions												
	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	0,5	0,6	0,6	0,7	0,8	0,9	1,1	1,4	1,4	1,4	1,4		
NL	0,7	0,8	0,9	1,0	1,2	1,4	1,7	1,9	1,9	1,9			
LU	0,7	1,1	1,9										
AT	1,0	1,0	1,1	1,2	1,3	1,5	1,7	1,9	2,2	2,4	2,4	2,4	2,4
FI	1,0	1,1	1,3	1,5	1,9	2,3	2,4	2,4	2,4				
FR	1,9	2,1	2,3	2,5	2,7	3,0	3,3	3,5	3,6	3,6	3,7	3,7	3,7
BE	2,6	2,8	3,0	3,2	3,4	3,7	3,9	4,3	4,5	4,7	4,7	4,8	4,8
EE	3,1	5,2											
SK	5,6	6,3	7,3	8,4	9,2	9,3	9,3	9,3	9,3				
IE	6,1	6,6	7,4	8,2	8,9	9,3	9,3	9,4	9,4	9,4	9,4		
LV	6,8	8,3	9,9	10,6	10,7	10,7							
LT	6,8	8,0	9,4	10,5	10,6	10,6	10,6						
MT	7,3	8,0	8,7	9,5	10,2	10,8	10,9	11,0	11,0	11,0	11,0	11,0	11,0
SI	8,2	9,1	10,2	11,3	11,9	11,9	12,1	12,1	12,1	12,1			
ES	6,8	7,5	8,2	8,9	9,7	9,8	9,9	9,9	9,9	9,9	9,9	9,9	
IT	7,2	7,6	8,0	8,5	9,0	9,4	9,8	10,3	10,4	10,5	10,5	10,5	10,6
PT	11,8	12,6	13,4	14,2	15,1	16,0	16,4	16,6	16,8	17,0	17,1	17,1	17,1
CY	16,1	16,9	17,9	18,8	19,7	20,8	22,0	22,4	22,8	23,3	23,9	24,6	24,6
EL	35,2	36,7	37,7	39,2	40,9	42,7	44,1	45,7	46,8	48,1	49,2	50,8	52,6
E-bond		0,0	0,0	0,2	0,3	0,6	0,9	1,3	1,7	2,1	2,4	2,7	2,9

Note: the last row shows the EL on E-bonds; a blank figure denotes a situation where the E-bond scheme size exceeds the amount of eligible sovereign debt outstanding as of year-end 2017, so that no national bonds are issued.

Source: Own calculations.

Table 13: Increase in credit risk premia of national bonds (in bps) per E-bond issuance size (as a % of GDP of the euro area and each Member State)

	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	30	+3	+7	+12	+18	+27	+39	+57	+75	+75	+75		
NL	47	+5	+12	+21	+33	+49	+74	+108	+117	+117			
LU	47	+27	+108										
AT	56	+4	+9	+15	+22	+30	+41	+54	+71	+93	+116	+116	+116
FI	42	+6	+13	+24	+39	+62	+88	+88	+88				
FR	70	+5	+11	+19	+27	+39	+52	+67	+84	+92	+92	+92	+92
BE	95	+6	+12	+20	+27	+37	+47	+61	+73	+91	+105	+116	+116
EE	146	+167											
SK	169	+23	+53	+95	+150	+194	+194	+194	+194				
IE	206	+20	+45	+76	+115	+162	+217	+235	+235	+235	+235		
LV	253	+55	+136	+261	+292	+292							
LT	226	+40	+92	+173	+267	+267	+267						
MT	216	+19	+41	+68	+102	+142	+193	+244	+249	+249	+249	+249	+249
SI	206	+23	+51	+93	+140	+200	+238	+238	+238	+238			
ES	152	+15	+31	+54	+82	+111	+151	+174	+174	+174	+174	+174	
IT	161	+8	+18	+28	+40	+54	+69	+86	+105	+127	+146	+169	+184
PT	244	+16	+33	+54	+77	+105	+137	+172	+222	+268	+282	+282	+282
CY	422	+22	+47	+75	+106	+141	+190	+237	+289	+351	+414	+483	+493
EL	382	+16	+29	+47	+67	+90	+108	+134	+164	+197	+223	+260	+302
E-bond		0	0	0	1	2	5	11	20	31	43	52	60

Note: based on the fuller-evidence assumptions; the first column shows the national (average) credit risk premia in the absence of E-bonds; the last row shows the (average) credit risk premia on E-bonds; a blank figure denotes a situation where the E-bond scheme size exceeds the amount of eligible sovereign debt as of year-end 2017, so that no national bonds are issued.

Source: Own calculations.

Table 14: Changes in average credit risk premia on total government debt (in bps) per E-bond issuance size (as a % of GDP of the euro area and each Member State)

	0% (no E-bonds)	5%	10%	15%	20%	25%	30%	35%	40%	45%	50%	55%	60%
DE	30	0	0	0	0	1	2	6	9	10	13	18	24
NL	47	0	0	0	0	1	2	4	0	-4	-4	4	11
LU	47	0	-2	-43	-43	-41	-39	-33	-25	-15	-4	4	11
AT	56	0	0	0	0	1	2	5	10	17	23	22	20
FI	42	0	0	0	0	1	-2	-10	-15	-9	0	8	15
FR	70	0	0	0	0	1	2	4	7	7	6	5	4
BE	95	0	0	0	0	1	1	4	6	12	15	17	13
EE	146	-93	-105	-105	-105	-104	-102	-98	-91	-83	-75	-68	-62
SK	169	0	0	1	-2	-20	-60	-97	-129	-134	-123	-114	-106
IE	206	0	0	0	-1	-3	-9	-33	-62	-87	-112	-137	-130
LV	253	1	0	-8	-81	-166	-225	-220	-211	-201	-191	-183	-175
LT	226	1	-1	-1	-20	-86	-152	-203	-194	-184	-173	-164	-157
MT	216	0	0	0	0	-1	-1	-8	-35	-62	-87	-112	-137
SI	206	0	-1	2	0	-5	-29	-69	-104	-136	-159	-150	-142
ES	152	0	-1	0	1	-2	-4	-17	-35	-52	-66	-81	-84
IT	161	0	0	0	1	1	2	4	7	11	14	16	13
PT	244	0	0	0	-1	0	0	0	5	5	-10	-30	-50
CY	422	0	-1	-1	-2	-2	4	5	7	10	9	4	-29
EL	382	1	-2	-1	0	2	-1	2	7	13	13	18	23

Note: average credit risk premia on total government debt is the weighted average of the premia paid indirectly on E-bonds issuance (via the senior loan) and of the premia paid on the remaining national debt (the junior part of which is shown in Table 13). The first column shows the national (average) credit risk premia in the absence of E-bonds. The columns show the average cost for the totality of outstanding debt of a country for a given E-bonds issuance threshold. Risk premia on ineligible debt (i.e., non-central government loans) is assumed not to change with respect to the situation of no E-bonds.

Source: Own calculations.